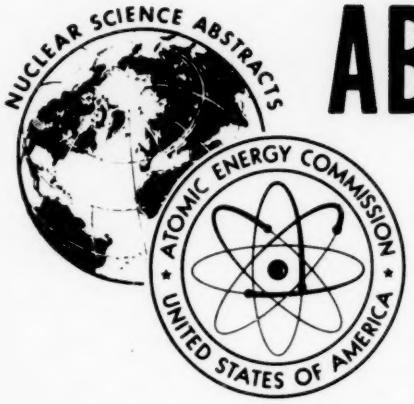
NUCLEAR SCIENCE ABSTRACTS



Volume 26 Number 1

Abstracts 1-1769

January 15, 1972

UNITED STATES ATOMIC ENERGY COMMISSION
Division of Technical Information

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of USAEC and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, AEC's Technical Progress Reviews, AEC-sponsored translations, conference proceedings published by AEC, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

ALABAMA
Auburn, Auburn University
Tuskegee Institute, Tuskegee Institute

ALASKA
College, University of Alaska

ARIZONA
Tucson, University of Arizona

ARKANSAS
Fayetteville, University of Arkansas

CALIFORNIA
Davis, University of California
Los Angeles, University of California

COLORADO
Boulder, University of Colorado

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

IDAHO
Pocatello, Idaho State University

ILLINOIS
Evanston, Northwestern University
Urbana, University of Illinois

INDIANA
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky
Louisville, University of Louisville

LOUISIANA
Baton Rouge, Louisiana State University
New Orleans, Tulane University

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Massachusetts Institute of Technology
Worcester, Worcester Polytechnic Institute

MICHIGAN
Ann Arbor, University of Michigan

MISSISSIPPI
State College, Mississippi State University

MISSOURI
Kansas City, Linda Hall Library

NEVADA
Las Vegas, University of Nevada

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Albany, New York State Library
Albany, State University at Albany
Buffalo, State University of New York at Buffalo
Ithaca, Cornell University
New York, Columbia University
Rochester, University of Rochester
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Raleigh, North Carolina State University

OHIO
Cincinnati, University of Cincinnati
Cleveland, Cleveland Public Library
Columbus, Ohio State University
Toledo, University of Toledo

OKLAHOMA
Norman, University of Oklahoma

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
San Juan, University of Puerto Rico

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee
Nashville, Joint University Libraries
Oak Ridge, Oak Ridge Associated Universities

TEXAS
Austin, University of Texas
College Station, Texas A & M University
Houston, Rice University

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin

WYOMING
Laramie, University of Wyoming

The following governmental and international organizations offer for sale USAEC reports abstracted in *Nuclear Science Abstracts*:

National Technical Information Service, U. S. Department of Commerce
Springfield, Virginia 22151
International Atomic Energy Agency, Vienna, Austria
National Lending Library, Boston Spa, England

Volume 26, Number 1, January 15, 1972

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director, Published by the USAEC Division of Technical Information Extension, Robert L. Shannon, Extension Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of international nuclear science literature. *Nuclear Science Abstracts* covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries:

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau–Atomic Energy Research Institute
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications, e.g., in the United States the American Institute of Physics provides page-proof copy of its publications.

A list of the journals scanned regularly and the abbreviations used appears in Issue 1 (January 15) of each volume of *Nuclear Science Abstracts* and is supplemented in Issues 7, 13, and 19. Issue 1 of each volume also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Division of Technical Information Extension, P.O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations abstracted in *Dissertation Abstracts* and included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Division of Technical Information Extension, P.O. Box 62, Oak Ridge, Tennessee 37830.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

For the 24 regular issues, the yearly rate is $42.00 for domestic subscribers and $52.50 for foreign subscribers. A single issue costs $1.75, domestic rates, or $2.19, foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

For a yearly subscription to the cumulative indexes, the rates are $34.50 for domestic subscribers and $43.00 for foreign subscribers.

The following cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:

Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

Vols. 5–10, Subjects and Authors (1951–1956), $5.25.

Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.

Vol. 21, Subjects and Authors (1967), $16.00.
Vol. 22, Subjects and Authors (1968), $26.00.
Vol. 23, Subjects and Authors (1969), $25.75.
Vol. 24, Subjects and Authors (1970), $22.50.
Vol. 24, Authors (1970), Suppl., $2.00.

Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.
Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.
Cumulative Report Number Index, Vols. 21–24, $4.25.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USAEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm microfilm in open reels or cartridges from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The backfile, which includes *Abstracts of Declassified Documents* (1947–1948), *Nuclear Science Abstracts* (1948–1969), *Nuclear Science Abstracts* cumulative indexes (1948–1966), and *Nuclear Science Abstracts* annual indexes (1967–1969), is $975. Yearly backfiles, beginning with 1970, and subscriptions, including cumulative indexes, are $125 per year.

INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated quarterly and annually. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summary below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted:

NEWCOMB, William A., Stability of a magnetic well, 25:1239
NEWKIRK, L. R., Superconductivity in the pseudobinary alloys V_3Si--Nb_3Al, 25:1093 (CALT-822-13)
NEWLAND, E. A., Radiation treatment of sewage, 25:140 (AAEC/LIB/Bib-254)

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

TRANSURANIUM ELEMENTS
determination in bone ash, radiochemical method for, 25:40 (IDO-12073, pp 28-36)
separation by ion exchange and complex-formation elution, 25:251(P)

TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

ORNL-		
4270(Vol.2)	25-614	Dep. NTIS
4606	25-1530	Dep. NTIS
ORNL-IBP-		
70-3	25-2025	Dep. NTIS
ORNL-IIC-		
21	25-261	Dep. NTIS
30(Pt.2)	25-331	Dep. NTIS
ORNL-NSIC-		
78	25-1912	Dep. NTIS

TABLE OF CONTENTS

Volume 26, Number 1, January 15, 1972

Category	Page
CHEMISTRY	1
Analytical Chemistry	1
Chemical and Spectral Procedures	1
Radiometric and Radiochemical Procedures	3
Activation Procedures	3
Inorganic, Organic, and Physical Chemistry	5
Chemical Properties	5
Isotope Effects and Exchange	6
Physical Chemistry	8
Radiation and Nuclear Chemistry	9
Radiation Effects	9
Radiation Processes	10
Radiolysis	11
Radioisotope Production	15
Recoil Production and Reactions	15
Radiochemistry	15
Separation Processes	16
EARTH SCIENCES	20
Geology and Hydrology	20
Meteorology	21
Mineralogy and Exploration	22
Oceanography	23
Seismology	23
ENGINEERING	25
Nuclear Explosions	25
Facilities and Equipment	26
Heat Transfer and Fluid Flow	28
Isotope Technology	29
Materials Testing	31
Radioactive Material Handling	32
Vacuum Engineering	34
INSTRUMENTATION	35
Radiation Detection Instruments	35
General Detectors and Monitors	35
Nuclear Spectroscopic Instrumentation	37
High Energy Physics Instrumentation	37
Radiation Dosimeters	38
Radiometric Instruments	39
Miscellaneous Instruments and Components	39
Radiation Effects on Instruments and Instrument Components	41
LIFE SCIENCES	42
Biochemistry, Physiology, and Molecular Biology	42
Immunology	42
Ecology	42
Genetics and Cytogenetics	42
Health Physics and Safety	42
Radioactive Contamination and Decontamination	42
Dosimetry and Monitoring	42
Radiation Protection	42

Category	Page
LIFE SCIENCES (Cont'd.)	
Medicine	42
Protective Substances	42
Radiation Sickness and Injuries	43
Radiodiagnosis	43
Radiotherapy	43
Blast and Thermal Effects	43
Radiation Effects on Animals	43
Vertebrates	43
Man	44
Radiation Effects on Plants	44
Radiation Effects on Microorganisms	44
Radiosterilization and Radiopreservation	44
METALS, CERAMICS, AND OTHER MATERIALS	45
Metals and Alloys	45
Corrosion and Erosion	45
Preparation and Fabrication	50
Properties Evaluations	52
Structure and Phase Studies	56
Radiation Effects	60
Ceramics and Cermets	61
Corrosion and Erosion	61
Preparation and Fabrication	62
Properties Evaluations	63
Structure and Phase Studies	64
Radiation Effects	67
Plastics and Other Materials	67
PHYSICS (GENERAL)	69
Astrophysics and Cosmology	69
Cosmic Ray Exposure Ages	69
Stars	69
Quasi-Stellar, Radio, and X-Ray Sources	70
Solar Phenomena	71
Galaxies	72
Cosmology	72
Planetary Phenomena	74
Atomic and Molecular Physics	74
Atomic, Electron, Ion, and Molecular Beams and Their Reactions	74
Atomic and Molecular Properties	75
Positronium, Muonium, and Mesic Atoms and Molecules	75
Collision Phenomena	75
Atomic Theory	77
Cosmic Radiation	77
Direct Energy Conversion	78
Fluid Physics	78
Upper Atmosphere Physics	79
Low-Temperature Physics and Cryogenic Equipment	82
Superfluidity	82
Superconductivity	82
Equipment and Devices	84
Plasma and Thermonuclear Physics	84
Confinement and Heating	84
Diagnostics	84

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (GENERAL) (Cont'd.)	
Kinetics (General)	85
Kinetics (Experimental)	86
Kinetics (Theoretical)	87
Production	88
Stability	89
Thermonuclear Processes	90
Wave Phenomena	91
Radiation Physics and Shielding	93
Radiation Physics	93
Shielding	93
Solid-State Physics	94
Radiation Effects	94
Physical Properties	96
Moessbauer Effects and NMR	99
Theory	100
Theoretical Physics	100
PHYSICS (HIGH-ENERGY)	102
Particle Interactions and Properties (Experimental)	102
Electromagnetic	102
Weak	102
Strong (Baryon-Induced)	102
Strong (Meson-Induced)	103
Particle Interactions and Properties (Theoretical)	103
General	103
Electromagnetic	104
Weak	104
Strong (General)	104
Strong (Baryon No. = 0)	105
Strong (Baryon No. = 1)	105
Strong (Baryon No. ≥ 2)	106
Particle Invariance Principles and Symmetries	106
General	106
Applications (Electromagnetic and Weak)	107
Applications (Strong)	107
Field Theories	107
General	107
Quantum Field Theory	107
Gravitation and General Relativity	109
Scattering Theory	109
Particle Accelerators	110
PHYSICS (NUCLEAR)	114
Neutron Interactions with Matter	114

Category	Page
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, A ≤ 5	116
Nuclear Properties and Reactions, 6 ≤ A ≤ 19	118
Nuclear Properties and Reactions, 20 ≤ A ≤ 89	121
Nuclear Properties and Reactions, A ≥ 90	126
Nuclear Theory	137
REACTOR TECHNOLOGY	144
Commercial Power Reactors	144
Operation and Economics	145
Safety and Siting	146
Steam and Power Conversion Systems	150
Power Reactor Development	150
Kinetics and Dynamics	151
Control Systems	151
Shielding	152
Cooling Systems	152
Fuels	152
Auxiliary and Emergency Systems	153
Operation and Economics	153
Safety and Siting	154
Power Conversion Systems	155
Research and Test Reactors	155
Rocket and Space Reactors	157
Process Heat and Desalination Reactors	158
Marine and Portable Power Reactors	158
Production Reactors	158
Reactor Theory	158
Kinetics	159
Dynamics	161
Experimental Applications	161
Reactor Components, Fuels, and Accessories	161
GENERAL	164
CORPORATE AUTHOR INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-12
SUBJECT INDEX	INDEX-48
REPORT NUMBER INDEX	INDEX-116
SCOPE AND SECTION ARRANGEMENT	APPENDIX-1
JOURNAL LIST	APPENDIX-23

STAFF OF NUCLEAR SCIENCE ABSTRACTS

John W. Norris
Managing Editor

Donald D. Davis
Assistant Managing Editor

David E. Bost
Production Manager

Sidney F. Lanier
Subject Heading Specialist

J. Paul Meredith
Descriptive Cataloging Specialist

Frederick E. Marsh, Jr.
Computer Index Coordinator

Clara L. Fox
Corporate Author Specialist

Helen W. White
Report Number Specialist

Section Editors

Everett J. Hoffman
Chemistry

Robert C. Kelly
Engineering; Earth Sciences; Metals, Ceramics, and Other Materials

Lee M. Thompson
General Physics

Charles E. Stuber
High Energy Physics; Instrumentation

Donald D. Davis
Life Sciences

Lawrence T. Whitehead
Nuclear Physics

James M. Jacobs
Reactor Technology

Evaluators

Thomas S. Chapman
John H. Mitchell
Mary H. Newman
Polly C. Summers

Abstractors

F. S. Armstrong*
Ellis R. Bedford
Jane G. Buchanan
D. Lamar Cason
Gloria M. Caton
David C. Cunningham
James R. Dulaney
Helga B. Gerstner
Mary C. Grissom
Phyllis C. Hansen
Carolyn D. Houston
Elaine E. Huber
W. Hugh Kinser, Jr.
Lisbeth C. Lieberman
Betty L. McDowell
Fay M. Martin
William D. Matheny
Dora H. Moneyhun
Jean F. Peckham
Henry D. Raleigh
Mona H. Raridon
Julia S. Redford
Jessie W. Rushing
Robert W. Rutkowski
Francis L. Sachs
Lila B. Smith
Anne G. Ward
Helen L. Ward
Kenneth S. Warren
Milton O. Whitson
Juanita Wilson

*Atomic Energy of Canada, Ltd.

Charles R. Bruce
Publishing Coordinator

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Managing Editor, *Nuclear Science Abstracts*, USAEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37830.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, June 26, 1969.

Volume 26, Number 1 January 15, 1972

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 217, 376, and 419.

1 (NBL-261) SAFEGUARDS ANALYTICAL LABORATORY EVALUATION (SALE) STUDY: URANIUM DIOXIDE. Lerner, M. W. (New Brunswick Lab. (AEC), N. J.). Sep 1971. 28p. Dep. NTIS.

A Safeguards Analytical Laboratory Evaluation (SALE) Study on uranium dioxide, designed to measure the accuracy and precision of uranium and ^{235}U abundance determinations by laboratories involved in processing this material, was carried out. The preparation of the reference material and the establishment of the reference values are described. Final statistical analyses of the results from the participating laboratories are presented. The methods used by the participants are also briefly evaluated. (auth)

2 ANION EXCHANGE IN ACETIC ACID SOLUTIONS. van den Winkel, P.; de Corte, F.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta; 56: No. 2, 241-59(Sep 1971).

The adsorbabilities of 65 elements in water-acetic acid medium on the anion-exchanger Dowex 1-X8 were investigated in the region 2 to 17.4 M acetic acid. Examples of possible individual separations of elements are given, namely: Cu-Zn, Mn-Cu-Zn, Na-As-Cu, and U-Np. A separation of the elements Ag, As, Au, Br, Co, Cu, K, Mn, Mo, Na, Sc, and Zn into four groups is described. A qualitative interpretation of the adsorption properties is proposed. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 51 and 598.

3 (AAEC/TM-596) TABLES OF CORRECTION FACTORS FOR USE IN THE PEAK/BACKGROUND RATIO METHOD OF X-RAY SPECTROCHEMICAL ANALYSIS. Champion, K. P.; Whittem, R. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1971. 9p. Dep. NTIS (U. S. Sales Only).

The tables provide factors for the K_α lines of elements Z = 23 to 42. (auth)

4 (CEA-R-4233) IMPROVEMENTS OF THE PRECISION IN THE DETERMINATION OF PLUTONIUM. I. DETERMINATION WITH REFERENCE TO A STANDARD PLUTONIUM. II. CALIBRATION OF A CERIC SOLUTION. Cauchetier, Philippe; Guichard, Claude (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Sep 1971. 78p. (In French). Dep. NTIS (U. S. Sales Only).

The method consists of reduction by titanous chloride and cerimetric titration of plutonium(III). The precision of this determination is such that by reference to a standard plutonium (NBS), the Pu content can be found within an interval of 0.05 percent. The accuracy of this method is confirmed by comparing the results obtained by three different methods using NBS As_2O_3, NBS $Na_2C_2O_4$, and NBS Pu to calibrate a ceric solution. These results indicate that the titer of this solution can be determined to within ±0.05 percent. The results are interpreted statistically and possible sources of error are discussed. (France)

5 DIRECT SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN METALLIC ZIRCONIUM. Kleinmann, I.; Vockova, J.; Hospes, M. Radioisotopy; 12: No. 1, 73-113(1971). (In Czech).

The determination of B, Cd, Hf, Gd, Eu, Dy, Sm, Ag, Mn, Co, Fe, and Ni in metallic zirconium is presented. Attention was given to choice of carrying agent and to internal comparison elements. Results give the possibility of simultaneous direct spectrographic determination of an element complex not yet described. (auth)

6 MASS SPECTROMETER CORRECTION FACTORS FOR THE DETERMINATION OF SMALL ISOTOPIC COMPOSITION VARIATIONS OF CARBON AND OXYGEN. Deines, P. (Pennsylvania State Univ., University Park). J. Mass Spectrom. Ion Phys.; 4: No. 4, 283-95(Jul 1970).

Mass spectrometer data of carbon and oxygen isotopic composition measurements obtained by comparison of a sample with a standard have to be corrected for differences in the instrumental components used for the measurement of sample and standard and for extraneous ion current contributions to the measured mass peaks. The experimental determination of five different correction factors and their application in the data reduction are discussed. (auth)

7 MASS DISCRIMINATION INTRODUCED BY THE OPTICAL PROPERTIES OF A SPUTTERING ION SOURCE DURING THE ISOTOPIC ANALYSIS OF LITHIUM IN STONY METEORITES. Gradsztajn, Eli.; Guez, Marcel (CNRS, Orsay, France). J. Mass Spectrom. Ion Phys.; 4: No. 4, 305-13(Jul 1970).

In the search for the origin of the $^7Li/^6Li$ anomalies found previously in stony meteorites, it has been observed that the use of a sputtering ion source in mass spectrometric measurements can introduce a variable mass discrimination. Depending on the operating conditions of the ion source, the deviation from the actual value of the isotopic ratio may be ±10%. It was found that the nature of the sputtering process, the geometry of the ion source, and the size of the sample analyzed are responsible for this isotopic discrimination. This finding leads to the conclusion that the observed variations of the $^7Li/^6Li$ ratio in stony meteorites described previously were due to an instrumental bias. (auth)

8 PRINCIPLES OF SEMI-QUANTITATIVE DETERMINATION OF ELEMENTS BY LASER-MICROSPECTROSCOPY. II. Schroth, Helga (Siemens AG, Munich). Z. Anal. Chem.; 255: No. 4, 257-60(1971). (In German).

The principles for the semi-quantitative determination of the following elements by laser-microspectroscopy were investigated separately for oxidic and metallic materials: Li, B, Na, P, K, Ca, Sc, Ti, Ge, Sr, Y, Nb, Pd, Te, Ba, La, Ce, Nd, Eu, Gd, Er, Yb, Lu, Hf, Ta, Ir, Au. (auth)

9 EMISSION-SPECTROMETRIC DETERMINATION OF TRACE RARE-EARTH ELEMENTS IN YTTRIUM OXIDE USING CsCl-GRAPHITE BUFFER. Osumi, Y.; Kato, A.; Miyake, Y. (Government Industrial Research Inst., Osaka). Z. Anal. Chem.; 255: No. 4, 264-8(1971).

An emission-spectrometric method was applied in the presence of CsCl-graphite buffer for the quantitative determination of traces of rare earth elements in yttrium oxide. The buffer causes an increase of the evaporation rate of the sample and of the emission intensity. The temperature in the arc plasma is decreased, and the atoms and ions of rare earths distribute uniformly along the axis of the discharge gap. The CsCl-graphite buffer enhances the sen-

sitivity and the precision of the analytical elements to a larger extent than other buffers and permits the determination of microquantities of 10 impurity elements within limits of detection from 1 to 20 ppM in high-purity yttrium oxide. The coefficients of variation are less than 20%. (auth)

10 AUTOMATIC MICROTITRATIONS WITH POTASSIUM HEXACYANOFERRATE(II) STANDARD SOLUTION. II. DETERMINATION OF DICHROMATE AND CERIUM(IV) IONS. Eross, K.; Buzas, I.; Erdey, L. (Technical Univ., Budapest). Z. Anal. Chem.; 255: No. 4, 273-4(1971).

Potassium hexacyanoferrate(II) solution was used as reducing standard solution for the determination of micro quantities of $Cr_2O_7^{2-}$ and Ce^{4+} ions by an automatic method using the titrimeter Radiometer TTT1-Titrigraph SBR2. (auth)

11 DETERMINATION OF IMPURITIES IN NUCLEAR GRADE SODIUM METAL. Silverman, Louis. International Series of Monographs in Analytical Chemistry, Volume 44. Oxford; Pergamon Press (1971). 152p. £ 3.75.

The subject is considered under methods for dissolving sodium metal, methods for preliminary bulk separations of the sodium in salts, and the sampling and handling of bulk sodium. Determinations of aluminum, bismuth, boron, cadmium, calcium, magnesium, carbon, cesium, chloride ion, chromium, cobalt, copper, hydrogen, iodine, iron, lead, lithium, manganese, nickel, oxide-oxygen, phosphorus, potassium, silicon, sulfur, and uranium are given. (UK)

12 MASS SPECTROSCOPY BEYOND THE MOON. Herzog, L. F. (Nuclide Corp., State College, Pa.). J. Mass. Spectrom. Ion Phys.; 4: No. 4, 337-63(Jul 1970).

Present knowledge of solar system composition and the kinds of data on various solar system components it is hoped to obtain through the space program, and the areas in which robot mass spectroscopy can be most useful are surveyed. Specific applications discussed include: determining planetary atmospheric compositions, classifying extraterrestrial rock, geological (radioactive parent/daughter) age determination, the detection of extraterrestrial life, determining the compositions of asteroids, comets and interplanetary dust, and the study of the solar wind and its effects. The mass spectrometric instrumentation available is reviewed and a recommendation is made for consideration of the development of two types of systems for space exploration—a low resolution mass spectrometer without pumping, possibly with hybrid TOF-coincidence-mass filter capabilities, and a medium resolution system with pumping, probably using a double-focusing ion analyzer with a permanent magnet. (auth)

13 EMISSION SPECTROSCOPY IN THE ANALYSIS OF NUCLEAR MATERIALS. Alvarez Gonzalez, F.; Roca Adell, M. Energ. Nucl. (Madrid); 15: No. 71, 176-89(May-Jun 1971). (In Spanish).

Spectrochemical analysis presents advantages of great sensitivity, simplicity, rapidity, and the possibility of determining simultaneously a large number of elements. The characteristics of the spectroscopic methods applied to geological prospecting and beneficiation of uranium ores, fabrication of fuel elements, moderators and coolants, structural materials, radioactive products, rare earths, gases in metals, and isotopic analysis are discussed. (100 references) (tr-auth)

14 RELATIVE SENSITIVITIES OF TWENTY ELEMENTS IN THE IRON MATRIX FOR SPARK-SOURCE MASS SPECTROMETRY. McCrea, J. M. (United States Steel Corp., Monroeville, Pa.). J. Mass Spectrom. Ion Phys.; 5: No. 1-2, 83-94(Oct 1970).

In conjunction with the analysis of zone-refined irons, the sensitivities of twenty elements (including Zr, Nb, Mo, and Ta) relative to iron were measured in a spark-source solids mass spectrometer. Three National Bureau of Standards standard reference materials were used for this calibration. Results agree satisfactorily with data from other laboratories provided the different calculation procedures of these laboratories are examined and used to present sensitivities in a uniform manner. Various practices in calculating sensitivity and correlations between sensitivities and other elemental properties are discussed. Use of sensitivities obtained has made results from the spark-source mass spectrometer more consistent with those from other methods calibrated against standard reference materials. (auth)

15 VOLUMETRIC DETERMINATION OF TITANIUM IN TITANIUM–NIOBIUM ALLOYS. Slama, Jaromir. Hutn. Listy; 25: No. 2, 132-4(Feb 1970). (In Czech).

A rapid method of volumetric determination of Ti in Ti–Nb alloys containing 40 to 75% Ti in the presence of low concentrations of Fe, N, W, Si, and Cu is described. The method is based on the Zn-amalgam reduction of Ti in an inert CO_2 atmosphere. The Ti is determined volumetrically as TiO_2. The accuracy is 5%. (Metals Abstr.)

16 PHOTOMETRIC DETERMINATION OF VANADIUM(V), TITANIUM(IV), MANGANESE(II), AND IRON(III) WITH N-HYDROXYSUCCINAMIC ACID (DI-POTASSIUM SALT). Bhargava, S. P.; Sogani, N. C. (Univ. of Rajasthan, Jaipur, India). Z. Anal. Chem.; 255: No. 3, 210-11(1971).

The dipotassium salt of N-hydroxysuccinamic acid forms water-soluble metal complexes, thus offering a suitable method for the photometric determination of vanadium(V), titanium(IV), manganese(II), and iron(III). The reagent develops an orange color with vanadium(V) (pH 2.0 to 3.5) and iron(III) (pH 4.0 to 8.9), intense yellow with titanium(V) (pH 0.8 to 4.2), red-violet with manganese(II) (pH < 9.0), light yellow with molybdenum(VI) (pH 3.0 to 9.0), uranium(VI) (pH 2.0 to 7.5), and tungsten(VI) (pH 3.0), and leaf green with copper(II) (pH > 4.0). (D.H.M.)

17 COMPLEXING OF URANIUM AND ALUMINUM WITH 1-(1-HYDROXY-4-METHYL-2-PHENYLAZO)-2-NAPHTHOL-4-SULFONIC ACID. ANALYTICAL APPLICATIONS. Bokra, Yobou (Faculte des Sciences, Poitiers, France); Luca, C. Chim. Anal.; 1: No. 1, 44-50(Jan-Mar 1971). (In Rumanian).

The acid-base dissociation equilibria of 1-(1-hydroxyl-4 methyl-2-phenylazo)-2-naphtholsulfonic acid (I) were studied spectrophotometrically and potentiometrically. The changes occurring in the absorption spectrum of acid (I) in the presence of UO_2^{2+} and Al^{3+} ions indicated the complexing thereof. By studying the complexes formed spectrophotometrically the stability constants were established as well as the required experimental conditions for the spectrophotometric determination of uranium and aluminum. A method for determining uranium in the presence of aluminum was also developed. (auth)

18 SEMIQUANTITATIVE MICROANALYSIS BY PAPER CHROMATOGRAPHY OF SMALL AMOUNTS OF CARBIDES EXTRACTED FROM STEELS. Suery, Peter (Sulzer AG, Winterthur, Switzerland). Z. Anal. Chem.; 253: No. 1, 34-5(1971). (In German).

A semiquantitative method was developed for the determination of Fe, Cr, Mo, and V in carbides isolated from steel. The method is applicable to samples of 50 μg or less. The elements are separated by paper chromatography. The mean error of the method ranges from 15 to 20%. Comparison with atomic absorption spectroscopy shows satisfactory agreement. (H.B.G.)

19 SPECTROPHOTOMETRIC DETERMINATION OF MICROAMOUNTS OF PLUTONIUM IN THE PRESENCE OF URANIUM. Yamamoto, Tadashi; Muto, Hiroshi; Kihara, Sorin; Motojima, Kenji (Japan Atomic Energy Research Inst., Tokai). Anal. Chim. Acta; 56: No. 2, 191-6(Sep 1971).

A rapid spectrophotometric method was developed for determination of plutonium in the presence of uranium. Plutonium is extracted with 0.2 M thenoyltrifluoroacetone in carbon tetrachloride from 0.5 M nitric acid solution. After washing the organic phase with 0.5 M perchloric acid solution, plutonium is back-extracted with a definite volume of 0.008% Arsenazo III–5.0 M perchloric acid solution. The absorbance of the aqueous phase is measured at 660 nm. By this method, 10 μg of plutonium can be determined in the presence of 1 g of uranium. The effects of diverse ions were studied. (auth)

20 POTENTIOMETRIC DETERMINATION OF CESIUM ION. Coetzee, C. J.; Basson, A. J. (Univ. of the Western Cape, Bellville, S. Afr.). Anal. Chim. Acta; 56: No. 2, 321-4(Sep 1971).

An electrode sensitive to cesium ion was prepared and used for the potentiometric determination of cesium. It was constructed from a membrane consisting of cesium 12-molybdophosphate embedded in a silicone rubber and then fixed to one end of a glass tube. (M.C.G.)

21 GRAVIMETRIC AND SPECTROPHOTOMETRIC DETERMINATION OF MERCURY WITH THIOSALICYLAMIDE. Mazumdar, M.; Shome, S. C. (Presidency Coll., Calcutta). Anal. Chim. Acta; 56: No. 1, 149-53(Aug 1971).

In dilute HCl, mercury forms a light yellow precipitate with thiosalicylamide that can be weighed as $Hg(C_7H_7ONS)_2Cl_2$ after drying at 110 to 120°C. The mercury precipitate is soluble in 50% ethanol and the ethanolic solution obeys Beers' law at 355 nm in the concentration range 3.90 to 23.40 μg Hg^{2+} ml^{-1}. The effects of various ions, including Th and U, on the determination were studied. (M.C.G.)

22 THIAZOLYL(-2-AZO-6)-1,3-DIHYDROXYPHENYL-4-CARBOXYLIC ACID (k-TAR) AS AN ANALYTICAL REAGENT. Kasiura, Krzysztof; Szczygielska, Maria (Politechnika, Warsaw). Chem. Anal. (Warsaw); 16: No. 3, 671-6(1971). (In Polish).

The reagent reacts with metal ions yielding red complexes (λ_{max} 510 to 560 nm). Molar absorptivity of these complexes is of the order of 1 to 3×10^4. The complexes are of medium strength. The Me : k-TAR mole ratio for Cu(II), In(III), and U(VI) is equal to 1 : 1, while that for Ni(II) is 1 : 2. The azo group of the reagent is protonated only in strongly acidic medium, while the nitrogen atom of thiazolyl ring is protonated also in less acid solutions. The carboxylic group dissociates in slightly acidic medium (pK 2.5 to 3) and the two hydroxyl groups in alkaline medium (pK 7.4 and 11.6, respectively). (auth)

23 MASKING AGENTS IN METAL TITRATION WITH EDTA. PART IV. THORIUM TITRATION IN THE PRESENCE OF SOME METALS. Costa, A. C. Spinola; Tavares, T. M. (Federal Univ., Bahia, Brazil). Anal. Lett. 3: No. 11, 549-61(Nov 1970).

The possible employment of various compounds containing sulfur as masking agents for divalent and trivalent metals in the titration of thorium with EDTA was explored. Reagents studied were thioglycolic acid, 3-mercaptopropionic acid, 2-mercaptoethanol, 2,3-dimercaptopropanol, bis(2-hydroxyethyl) dithiocarbamate, ethyl xanthate, thionalide, thiourea, and thiosulfate. The ones that proved more efficient were 2,3-dimercaptopropanol and bis(2-hydroxyethyl) dithiocarbamate. (auth)

24 MASS SPECTROMETRIC DETERMINATION OF BURN-UP CHARACTERISTICS FROM MEASURED ISOTOPIC COMPOSITION OF NEODYMIUM IN FISSION PRODUCTS. Bulovic, V. (Boris Kidric Inst. of Nuclear Sciences, Belgrade); Djordjevic, M.; Maximovic, Z.; Krtil, Josef; Moravec, Antonin. Jad. Energ.; 17: No. 8, 259-64(Aug 1971).

The calculation of the complete data of the burnup of nuclear fuel from mass spectrometric measurement of all stable fission isotopes of neodymium is described. The inferred formulas for the calculation of the amount of individual neodymium isotopes and for the number of fissions were used for the determination of the burnup in two samples of real nuclear fuels. The results obtained were compared with the results of radiochemical measurements. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 142, 295, and 330.

25 (AECL-3964) ADSORPTION OF TELLURIUM FROM AQUEOUS SOLUTION. Edwards, W. J.; Bateman, J. M. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jun 1971. 30p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

One method for locating defective fuel in pressurized water nuclear reactors is the measurement of a suitable fission product, selected by high resolution γ spectrometry, and collected on "traps" placed in the coolant system for that purpose. Radiotellurium is a possible fission product and nickel oxide, or hydroxide, a potential trap for this method of detection. The absorption of tellurium on nickel hydroxide and oxide was therefore studied in laboratory experiments. The present status of the investigation is reported. Results are given for the variation of adsorption as a function of pH. A simple hypothesis to account for these results and to guide further work is outlined. This hypothesis may also be applicable to the deposition of other radioactive species on reactor coolant components. (auth)

26 (NP-19005) APPARATUS AND METHOD FOR THE MEASUREMENT OF NATURAL ABUNDANCE OF TRITIUM. Technical Paper No. 3. Hughes, M. W.; Holmes, J. W. (Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils). 1971. 15p. Dep. NTIS (U. S. Sales Only).

Greater sample enrichment, combined with internal gas proportional counting, is essential for measurement of tritium abundance in the Southern Hemisphere where rainwater content varies between 10 and 60 T. U. (tritium unit). A description is given of equipment and techniques used by CSIRO for tritium determination in rain, river water, and underground water. Calculation examples are detailed and some results obtained in the Adelaide area are discussed. (Australia)

27 (SC-RR-710535) DETERMINATION OF THE Si AND Ge CONTENT IN SiGe ALLOY BY GAMMA RAY ABSORPTION SPECTROSCOPY. Nelson, G. C. (Sandia Labs., Albuquerque, N. Mex.). Sep 1971. 18p. Dep. NTIS.

Gamma absorption spectroscopy has been used to accurately determine the Si and Ge content in SiGe systems. This technique provides a fast, accurate, and nondestructive method for determining concentrations of components in binary systems. (auth)

28 MEASUREMENT OF THE RADIOACTIVITY OF NATURAL WATERS. Biro, Tomas; Grisanti, Alvaro; Tori, Paolo (Inst. of Isotopes, Budapest). Ann. Ist. Super. Sanita; 6: 95-105(1970).

The exposure of man to external and internal radiation is determined by environmental radioactivity that may contribute significantly to the overall radiation exposure. The opportunity to set up radiochemical techniques suitable for the analysis of water was presented by the necessity for controlling the radioactivity present in the natural water from the Fontana Nuova well in Buggiano (Spoleto). A careful radiochemical study of this water and of the normal tap-water (Acqua Marcia) used in Rome was then undertaken. (auth)

29 GAMMA SPECTROMETRIC DETERMINATION OF RADIOISOTOPES IN SOILS. Yastrebov, M. T. (Moscow State Univ.). Vestn. Mosk. Univ., Ser. VI, Biol. Pochvoved.; 25: No. 5, 75-80(1970). (In Russian).

Two five-channel analyzers, coupled with a spectrometer with a NaI(Tl) crystal, were used in the simultaneous gamma-spectrometric determination in soils of the naturally occurring ^{238}U, ^{226}Ra, ^{232}Th, and ^{40}K isotopes and the artificial radionuclides ^{137}Cs, ^{144}Ce, and ^{106}Ru. Short-lived fission products were neglected because of their small contribution to the total radioactivity at the time of the study. Good reproducibility was demonstrated by four repeated determinations on a sample containing the seven isotopes. The threshold of sensitivity of the gamma-spectrophotometric apparatus used was: ^{238}U, 1.2×10^{-4}%; ^{226}Ra, 1.5×10^{-11}%; ^{232}Th, 0.8×10^{-4}%; ^{40}K, 1.3×10^{-4}%; ^{137}Cs, 2.0×10^{-10}; ^{144}Ce, 1.0×10^{-9}; ^{106}Ru, 4.2×10^{-9} Ci. (K.S.W.)

30 APPLICATIONS OF RADIOISOTOPES AND RADIATION TECHNOLOGY TO CHEMICAL ANALYSIS. Kato, Masao; Sato, Otomaru (Tokyo Univ.). Seisan Kenkyu; 23: No. 2, 59-66(Feb 1971). (In Japanese).

The application of radioisotopes and radiation to analytical chemistry is described. First, an outline of activation analysis is given. The activatable tracer method, which is used as a powerful method to investigate air and water pollution, is also described. Secondly, various kinds of radioanalytical methods, such as isotope dilution, substoichiometric analysis, the isotope exchange reaction method, the concentration-dependent distribution method, the isotope derivative method, the isotope displacement method, the radiochemical release method, and radiometric titration are described. Finally, analytical methods using radioisotopes as radiation sources are described. Methods using penetration and scattering of charged particles, methods using penetration and scattering of x and γ rays, methods using neutrons, fluorescence x-ray analysis, x-ray diffraction, Mössbauer effect, application of ionization interaction, use of neutron capture γ rays and inelastically scattered γ rays are described. (TACHIYA, M.) (Japan)

31 DETERMINATION OF ACCURACY AND PRECISION LIMITS FOR TRITIUM IN WATER. Knowles, Forrest E. Jr.; Baratta, Edmond J. (Public Health Service, Winchester, Mass.). Radiol. Health Data; 12: No. 8, 405-9(Aug 1971).

The procedure for establishing a standard deviation (σ) value for analysis of tritium in water is described and the results of a technical experiment to test the validity of this value discussed. Since many State, Federal, and local laboratories are analyzing this radionuclide on a routine basis a procedure of quality control to assist in producing comparable and accurate data is necessary. As more nuclear power reactors and nuclear fuel reprocessing plants become operative, tritium will be introduced into the environment in greater quantities. Therefore, other agencies are preparing for tritium analysis capability and will be depending upon this quality control program to assess equipment and sample preparation capabilities. A standard deviation of 10% for single determinations for values equal to or greater than 5 nanocuries per liter was established by assessing data from a tritium cross-check program conducted by the Analytical Quality Control Service of the Office of Radiation Programs, Environmental Protection Agency (EPA). The technical experiment results confirmed this value. (auth)

Activation Procedures

Refer also to abstracts 358, 704, and 1302.

32 (BNFL-26) SET OF NUMERICAL SUBROUTINES FOR USE WITH A BASIC (4K) PDP8-L COMPUTER. Sanderson, J. R.

(British Nuclear Fuels Ltd., Risley (England)). 1971. 86p. Dep. NTIS (U. S. Sales Only).

Utility and numerical subroutines which can be loaded into a basic (4K) PDP8 computer are described. Curve fitting by least squares, solution of simultaneous equations by Gauss Jordan matrix inversion, interpolation by Aitken's method and integration using Bessel's equation are included in the numerical routines. The utilities include methods for handling real arrays, I/O option selection and modifications to the DES floating point system. Programs are also available which load data and print results when used in connection with individual subroutines. (auth)

33 (KFK–1404) DETERMINATION OF TUNGSTEN CONTENT OF NATURAL STONE SAMPLES FROM SCHEELITE DEPOSITS WITH THE HELP OF PROMPT (n,γ) ANALYSIS. Fanger, U.; Heck, D.; Martens, P.; Pepelnik, R.; Schmidt, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Jun 1971. 18p. (In German). Dep. NTIS (U. S. Sales Only).

Six mineral samples from scheelite camps in Austria were irradiated with thermal neutrons at the Karlsruhe FR-2 reactor and their promptly emitted gamma radiation analyzed in the energy range from 2.5 to 8.5 MeV. A method is deduced and discussed, which allows the determination of element concentration independent of neutron flux, geometry, and sample mass. The application of this method on the spectra measured yields results which agree quite well with the chemical data as far as known. (auth)

34 (KFK-EXT–10/70-3) CALCULATION OF THE ACTIVITY PRODUCED BY IRRADIATION OF THIN TARGETS WITH ENERGETIC NEUTRONS. PROGRAM NEURAK. Muenzel, H.; Schmidt, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Oct 1970. 39p. (In German). INIS.

A computer program is described whereby the activities produced by the bombarding of thin targets with high-energy neutrons may be calculated. The program requires values for the excitation function and for the neutron spectra. (INIS)

35 (LYCEN–7136) CHARGED-PARTICLE ACTIVATION DETERMINATION OF OXYGEN IN Mo, Pb, AND Pb–Sb ALLOYS. Faure-Mazagol, Lyliane (Lyon Univ. (France). Institut de Physique Nucleaire). Jun 1971. 54p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The distribution of oxygen in molybdenum was studied. The determination of the oxygen content was effected using α particles; direct observation of the nuclear reactions produced by low-energy deuterons was used to analyze the oxygen in the surface layers, the results of this analysis being compared with those obtained by mass spectrometry in the case of samples purified by zone refining. The energy loss curves for 54-MeV α particles in lead were plotted in the course of studying the oxygen content of lead and antimonial lead. It was necessary to undertake a highly refined chemical separation of fluorine from iodine. The separation of fluorine by extraction with diphenyldichlorosilane in solution with isopropyl ether produced very good results. Such a separation is fast and does not require complicated equipment. (France)

36 (MLM–1848) COMPUTER PROGRAM FOR THE ANALYSIS OF NEUTRON ACTIVATION DATA: GAMMA SPECTRUM SMOOTHING AND SAMPLE CALCULATION. Gillette, R. K. (Mound Lab., Miamisburg, Ohio). 30 Sep 1971. Contract AT-33-1-GEN-53. 41p. Dep. NTIS.

Sample calculations can be performed when a standard and sample are counted successively on the same crystal, correcting the standard for decay to the time of the sample count. The computer program is written in FORTRAN IV for use on the IBM 360/50 computer. This program is designed to perform gamma spectrum smoothing of activation analysis data gathered from a 400-channel analyzer. The main objective of the program is for the data handling of routine 14-MeV neutron activation analysis data. (auth)

37 DETERMINATION OF NITROGEN IN ORGANIC MATERIALS BY PROMPT (n,γ) TECHNIQUE. Tiwari, P. N.; Bergman, R.; Larsson, B. (Uppsala Univ.). Int. J. Appl. Radiat. Isotop.; 22: No. 10, 587-92(Oct 1971).

The 10.82-MeV γ rays emitted in the prompt (n,γ) reaction on nitrogen were used to determine the content of nitrogen in organic materials. A $^{241}Am-Be$ source with a yield of 2.5×10^5 neutron/sec was employed as neutron source. A neutron gun was fabricated, which thermalized, the neutrons and concentrated them towards the sample. Urea (H_2NCONH_2) was chosen as sample for analysis and glucose ($C_6H_{12}O_6$) taken for the background spectrum. The γ spectra of both urea and glucose are given and differ only in the 10.82-MeV region. This region was utilized for preparing the calibration curve, which is nonlinear. This nonlinearity is explained. The application of the technique in agricultural research work is discussed. (auth)

38 STUDY OF DELAYED NEUTRON EMITTERS OBTAINED BY ACTIVATION OF CERTAIN LIGHT ELEMENTS BY MEANS OF γ PHOTONS. Scherle, A. C.; Engelmann, Ch. (CEA, Saclay, France). Radiochim. Acta; 16: No. 1, 11-14(Aug 1971).

Under the program of research on the possibilities offered by nuclear methods of analysis by charged particle and γ photon activation, the delayed neutron emission was studied following the photonuclear reactions: $^{18}O(\gamma,p)^{17}N$, $^{19}F(\gamma,2p)^{17}N$, $^{11}B(\gamma,2p)^{9}Li$, obtained with a bremsstrahlung beam of maximum energy 40 to 62 MeV. The cross sections of these reactions were determined in this energy region by a method derived from the photon difference method. (auth)

39 AREAWIDE TRACE METAL CONCENTRATIONS MEASURED BY MULTIELEMENT NEUTRON ACTIVATION ANALYSIS. A ONE DAY STUDY IN NORTHWEST INDIANA. Harrison, P. R. (Univ. of Michigan, Ann Arbor); Rahn, K. A.; Dams, R.; (and others). Contract AT(11-1)-1705. J. Air Pollut. Contr. Ass.; 21: No. 9, 563-70(Sep 1971).

A suite of 24 hour high volume air particulate samples, collected June 11–12, 1969, at 25 locations in the Northwest Indiana area, were analyzed by nondestructive neutron activation analysis for 30 trace elements. The use of Ge(Li) gamma-ray spectrometry and computer assisted data reduction, combined with 2 to 4 replications of each analysis, yielded precise results, which allowed a study of the geographical distribution patterns of the elements. Some elements, such as Na, K, Ti, Al, Sm, and Eu, show only minor concentration variations over the area, while others, such as Cu, W, Cr, Zn, Sb, Ga, Br, Ag, Fe, and Ce, show large variations, indicative of important local sources. Similar distribution patterns and high correlation coefficients suggest common sources for several elements. The variations of most heavy elements significantly exceed previously reported variations of total particulate, indicating the latter to be an unsatisfactory guide for elemental distribution, especially near pollution sources. Three representative locations for measurement of elemental abundances in the area are suggested. The influence of meteorological conditions and the potential Lake Michigan pollution hazard are discussed. (auth)

40 ANALYSIS OF SODIUM IN THE NAILS BY MEANS OF NEUTRON ACTIVATION. Carmello Gandolfo, Maria Teresa; Strigazzi, Alfredo (Ospedale Maria Vittoria, Turin. Politecnico, Turin). Fracastoro; 63: No. 3-4, 340-6(May-Aug 1970). (In Italian).

Neutron activation analysis was used to measure Na concentration in children's nails in an effort to detect early cystic fibrosis subjects, who show usually a considerable increase in nail Na content. This method, which requires very small quantities of nails, is simple, precise, and rather cheap in comparison with other methods. (auth)

41 PURELY INSTRUMENTAL APPROACH TO THE MULTIELEMENTAL ANALYSIS OF BIOLOGICAL TISSUE. Haller, William Aloysius. Pullman, Wash.; Washington State Univ. (1971). 101p. University Microfilms Order No. 71-18,573.

Thesis.

A method of instrumental neutron activation analysis capable of determining 16 to 23 elements in a single biological sample is described. This instrumental method, which requires no chemical or ashing manipulations, eliminates many inherent errors associated with chemical determinations. The contribution of sample contamination, secondary reactions, reactor variables, geometry, counting statistics, self shielding, and possible gamma-ray interferences to the absolute variation in the determination of each element are considered. (Diss. Abstr. Int., B)

42 DETERMINATION OF GOLD BY NON-DESTRUCTIVE ACTIVATION ANALYSIS FOR PURPOSES OF GEOCHEMICAL AND GEOBOTANICAL PROSPECTING. Schiller, P.; Cook, G. B.; Beswick, C. K. (IAEA Lab., Seibersdorf, Austria). Mikrochim. Acta; No. 3, 420-8(1971).

The correlation between the gold content of rocks, ores, and natural waters and plants from gold-bearing areas for purposes of geochemical and geobotanical prospecting is being investigated. Nondestructive activation analysis was found to be advantageous for these purposes. The preliminary field study of samples obtained from an abandoned gold mine in the Bockhart area near Bad Gastein in Austria and from its environment is also described. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 133, 141, and 419.

Chemical Properties

Refer also to abstract 502.

43 (ARH-808) MOLTEN SALT SYSTEMS FOR THE DIRECT OXIDE REDUCTION PROGRAM. Skinner, J. K.; Felt, R. E. (Atlantic Richfield Hanford Co., Richland, Wash.). 29 Aug 1968. Contract AT(45-1)-2130. 13p. Dep. NTIS.

The Direct Oxide Reduction (DOR) process produces plutonium metal by the direct reduction of PuO_2 by an active metal. The plutonium metal must settle out of the molten salt-active metal melt, and the active-metal oxide that collects in the salt must be disposed of. Selection of the optimum salt system for this process is now possible. The two criteria are (1) low melting point (with consequent low viscosity at higher temperatures) and (2) high calcium or magnesium oxide solubility. The optimum system for use with a calcium reductant appears to be 80 mole % $CaCl_2$–20 mole % CaF_2. The following systems were studied: LiCl–KCl–NaCl, $CaCl_2$–CaF_2, and $CaCl_2$–CaF_2–LiCl. (M.C.G.)

44 (CONF-711019-1) BINARY SOLID SOLUTIONS OF PaO_2 AND OTHER ACTINIDE DIOXIDES AND THEIR EXCHANGE EQUILIBRIA WITH MOLTEN SALT REACTOR FLUORIDES. Bamberger, C. E.; Ross, R. G.; Baes, C. F. Jr. (Oak Ridge National Lab., Tenn.). [1971]. 25p. Dep. NTIS.

From fifth materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971).

ThO_2, PaO_2, UO_2, and PuO_2 are relatively insoluble in the molten fluoride mixtures that serve as the fuel of the molten salt nuclear power reactors (MSR's). Since these dioxides can form substitutional solid solutions, exchange reactions of the type $ThO_2(ss) + MF_4(d) \rightleftharpoons ThF_4(d) + MO_2(ss)$ [$Q^M_{Th} = (X_{MO_2}/X_{ThO_2}) \cdot (X_{ThF_4}/X_{MF_4})$] involving the solid solution (ss) and the molten fluoride phase (d) become possible. A study of the exchange reaction involving Pa^{4+} and Th^{4+} was carried out in which PaO_2–ThO_2 solid solutions ($X_{PaO_2} \leq 0.3$) were formed by equilibration of ThO_2 with molten LiF–BeF_2–ThF_4 (72–16–12 mole %) in the temperature range 580 to 730°C. The resulting values of the distribution quotient Q^{Pa}_{Th}, along with previously measured values of Q^{U}_{Th} and a value of Q^{Pu}_{Th} derived indirectly from other previous measurements, are consistent with the following expressions: $\ln \gamma_{MO} = [(1228 \pm 150/T)(\Delta a/a_{ThO_2})^2 X^2_{ThO_2}]$; $\ln \gamma_{ThO_2} = [(1228 \pm 150/T)(\Delta a/a_{ThO_2})^2 X^2_{MO_2}]$; and $\ln Q^M_{Th} = [(1318 \pm 27/T)(\Delta a/a_{MO_2}a_{ThO_2})] + (1228 \pm 150/T)(\Delta a/a_{ThO_2})^2 (2X_{MO_2} - 1)$; which relate the activity coefficients in the solid solution and the exchange quotient to the difference in the lattice parameters (Δa) of MO_2 and ThO_2. (auth)

45 (RD/B/N-2065) PURIFICATION OF CARBON MONOXIDE. Whittle, I. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug 1971. 9p. Dep. NTIS (U. S. Sales Only).

A critical review is presented of the methods of purification of CO. Details of the method adopted during the study of the reaction of U with CO are described. Activated charcoal was used to remove O_2, and magnesium perchlorate and phosphorus pentoxide to remove water vapor. (UK)

46 (RFP-1707) LABORATORY STUDY ON METHODS TO REDUCE PLUTONIUM HEXAFLUORIDE TO PLUTONIUM TETRAFLUORIDE. Wing, Ralph O.; Nau, Robert J. Jr. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 14 Oct 1971. Contract AT(29-1)-1106. 8p. Dep. NTIS.

A comparison of three methods to reduce impurity-spiked plutonium hexafluoride (PuF_6) to plutonium tetrafluoride (PuF_4) was made to determine the purity levels obtained from each method. The three methods compared were water hydrolysis, hydrogen reduction, and thermal decomposition. The thermal decomposition method was determined to be the best, both for low-level impurities and for physical handling of the PuF_4 product. (auth)

47 Ca^{2+}/H^+ EXCHANGE ON ZIRCONIUM PHOSPHATE AT TEMPERATURES UP TO 250°. Ruvarac, Aleksandar Lj. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Chromatogr.; 60: No. 2, 235-9(26 Aug 1971).

The ion exchange of trace amounts of $^{45}Ca^{2+}$ on amorphous zirconium phosphate as a function of temperature and concentration of nitric acid was studied. The effects of temperature, at constant pressure (80 atm), was investigated as a function of nitric acid concentrations in aqueous solution. The experiments were made at 25, 50, 110, 150, 200, and 250°C. Ion exchange of $^{45}Ca^{2+}$ decrease with increasing temperature in the investigated temperature range. From these results, equilibrium constants for the Ca^{2+}/H^+ ion exchange on amorphous zirconium phosphate and thermodynamic quantities for these reactions were calculated. (auth)

48 PAPER ELECTROPHORETIC STUDY OF ION-PAIR FORMATION. VII. THE EFFECT OF IONIC SIZE ON ION-PAIR FORMATION. Sinibaldi, M.; Lederer, M. (CNR, Rome). J. Chromatogr.; 60: No. 2, 241-7(26 Aug 1971).

The electrophoretic movement of chlorate, bromate, and iodate was studied using a wide range of metal salts as electrolytes. The separation effects were interpreted as differences in the degree of ion-pair formation. In Fe(III), Zr(IV), and Th(IV) nitrates, iodate moves cationically. (auth)

49 NEW METHODS FOR REDUCING URANIUM HEXAFLUORIDE. Hartmanshenn, Olivier; Barral, J. C. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C; 272: No. 26, 2139-40(28 Jun 1971). (In French).

The reduction of uranium hexafluoride was activated at room temperature using ultraviolet radiation. Various reducing agents (H_2, CO, and SO_2) were used, all of which produced β-UF_5. (France)

50 PHOTOCHEMICAL REDUCTION OF URANYL ACETATE. Giorgio, G. (Institut National des Sciences Appliquees, Villeurbanne, France). Ann. Chim. (Paris); 6: No. 1, 53-66 (Jan 1971). (In French).

The photochemical reduction of uranyl acetate by ethyl alcohol in a water–acetic solution and in anhydrous acetic acid, led to $UO(CH_3COO)_2$ and $U(CH_3CO)_4$ respectively, the latter being isomorphous with $Th(CH_3COO)_4$ and $Ce(CH_3COO)_4$. The different products evolved during the photochemical reaction in the liquid and gaseous phases were analyzed at 160°C and 40°C using gas chromatography. The amount of U(IV) was continuously analyzed by spectrophotometric absorption at 6,500 Angstroms. The results obtained indicate that the process essentially yields acetaldehyde and uranium(IV) according to the reaction: $UO_2^{2+} + C_2H_5OH + 2\,H^+ \rightarrow U^{4+} + CH_3CHO + 2\,H_2O$, which implies going through the intermediate species U(V). The different secondary reactions leading to methane and carbon dioxide in the gaseous phase and to formic and acetic acids in the liquid phase were also established. The spectral range in which the photochemical reduction of uranyl acetate appears to be the most satisfactory lies between 3,500 and 5,000 Angstroms. (France)

51 MASS-SPECTROMETRIC OBSERVATIONS OF URANIUM AND PLUTONIUM MONOHYDRIDES FORMED BY ION-MOLECULE REACTION. Moreland, P. E. Jr.; Rokop, D. J.; Stevens, C. M. (Argonne National Lab., Ill.). J. Mass Spectrom. Ion Phys.; 5: No. 1-2, 127-36(Oct 1970).

The monohydride ions UH^+, UD^+, PuH^+ and PuD^+ were observed in the mass spectrum of U and Pu during the isotopic analysis of these metals by surface ionization mass spectrometry. By introducing hydrogen and vapors of hydrogen compounds into the ion source, the hydrides are found to be produced by endothermic ion–molecule chemical reactions of the metal-ion beam and residual gases. Hydride product ions were obtained with measurable intensity for the systems: $U^+ + H_2$, $U^+ + D_2$, $U^+ + H_2O$, $U^+ + D_2O$, $U^+ + H_2S$, $Pu^+ + H_2$, and $Pu^+ + D_2$. Analysis of relatively crude product-ion energy spectra permit the dissociation energy $D_0(U^+ - H)$ to be estimated at 3.3 ± 0.5 eV. The use of a retarding potential as a high-pass energy filter permits complete rejection of hydride ions in the mass spectrometer, due to the endothermic nature of the reactions involved. (auth)

52 FLUORO COMPLEXES OF HEXAVALENT URANIUM. III. COMPLEXES OF THE SERIES $[UO_2F_4]^{2-}$. Chakravorti, M. Ç. (Indian Inst. of Tech., Kharagpur, India); Bandyopadhyay, N. J. Inorg. Nucl. Chem.; 33: No. 8, 1565-71(Aug 1971).

Complex uranyl fluorides of the general formulae $BH_2[UO_2F_4] \cdot nH_2O$, $M^{II}[UO_2F_4] \cdot nH_2O$, and $M^I_2[UO_2F_4] \cdot nH_2O$ where B = organic diamine base, viz. biguanide and phenyl biguanide, $M^{II} = Ba^{2+}$ and bivalent complex cations $[Ni(py)_4]^{2+}$ or $[Ni(en)_3]^{2+}$ and M^I = alkali metals Na^+, K^+ and NH_4^+ were isolated in pure state. The compounds with organic bases were obtained by mixing the organic base fluorides with uranyl fluoride in 20% HF medium. The compounds with complex cations were obtained by the action of pyridine or ethylenediamine on a mixture of nickel fluoride and uranyl fluoride. The Na^+, K^+, and NH_4^+ salts were obtained by the metathesis of the compounds containing complex cations with $NaClO_4$, KI, and NH_4I, respectively. The barium salt was obtained by the metathesis between the potassium salt and $BaCl_2$ in the presence of boric acid. The solubilities of some of the salts in water were determined. The salts were characterized by elemental analysis,

metathesis studies, conductivity measurement, thermogravimetric analysis and ir spectral studies. (auth)

53 SPECTROPHOTOMETRIC EXAMINATION OF THE REACTION OF N-PHENYLTHIOACETOHYDROXAMIC ACID (KFTAH) WITH Fe(III) IONS. I. DETERMINATION OF ACID DISSOCIATION CONSTANT OF THE REAGENT AND THE COMPOSITION OF THE COMPLEXES. Minczewski, Jerzy; Boguszewska, Zofia; Skorko-Trybula, Zofia (Politechnika, Warsaw). Chem. Anal. (Warsaw); 16: No. 3, 611-18(1971). (In Polish).

Three different colored complexes are gradually formed in the system: N-phenylthioacetohydroxamic acid– Fe(III) ions. The solutions investigated change color with pH increase from pinkish violet through red to orange. The composition of the complexes in water–acetone solutions was determined by Jab's method as well as by spectrophotometric titration. It was found that three gradually formed complexes with metal to ligand ratio of 1:1, 1:2, and 1:3 exist. The value of the acid dissociation constant of N-phenylthioacetohydroxamic acid in aqueous solution as determined by potentiometric and spectrophotometric methods is 7.4×10^{-2}. Data are also given on the reactions of Mo(VI), V(V), and U(VI) with N-phenylthioacetohydroxamic acid. (auth)

Isotope Effects and Exchange

Refer also to abstracts 126, 171, and 977.

54 KINETIC ANALYSIS OF ISOTOPE EXCHANGE IN A SYSTEM OF CONCENTRIC CYLINDERS. Fraidenraich, Naum (Observatorio Nacional de Fisica Cosmica, Buenos Aires); Cereijido, Marcelino. J. Theor. Biol.; 32: 107-22(1971).

A kinetic analysis of isotopic exchange between a constant reservoir and a system consisting of two concentric cylinders separated from each other by a barrier was performed in order to characterize the transport properties of the system. Although the system was designed on the basis of the anatomical features of a seminiferous tubule, its general nature makes it applicable to other preparations (e.g., a kidney tubule). The inner cylinder in which the diffusion coefficient is infinite, is taken to represent "the lumen". An equation describing the space time course of the penetration of tracer is derived from Fick's second law. Several limiting cases are discussed: (a) the case given when the barrier separating the two cylindrical compartments is totally impermeable; (b) the case given when the barrier is slightly permeable; (c) the situation presented when it offers no significant resistance to tracer movement; (d) the case given when the lumen is negligible and the whole tubule is represented by a homogeneous cellular component. Consideration is also given to the opposite case, i.e., when the radius of the lumen is almost equal to the external radius of the cylinder. As a result of the analysis a method is given to evaluate the main unknown parameters (diffusion coefficient in the cellular compartment, permeability of the inner barrier, and radius of the lumen) from measurements of M_t/M_∞. A graphical representation of the theoretical analysis is given. It facilitates the interpretation of the diffusion process based on the measurement of M_t/M_∞. (auth)

55 RELATIVE RATES OF ISOTOPIC HYDROGEN ATOM-MOLECULE REACTIONS. Quickert, Klaus Arthur. Toronto; Univ. of Toronto (1969). National Library of Canada, Ottawa. Thesis.

The method of relative rates was applied to the isotopic hydrogen atom–molecule reactions $H + H_2 \rightarrow H_2 + H$, k_1; $D + D_2 \rightarrow D_2 + D$, k_2; $D + H_2 \rightarrow DH + H$, k_3; $H + D_2 \rightarrow HD + D$, k_4. The rate constant ratio, k_1/k_4, was determined over the temperature range 290 to 690°K, with a precision of ~10% or better. (TSS)

56 INFRARED AND RAMAN SPECTRA OF SUBSTITUTED HYDRAZINES. III. SYMMETRICAL DIMETHYLHYDRAZINE. Durig, J. R.; Harris, W. C. (Univ. of South Carolina, Columbia). J. Chem. Phys.; 55: No. 4, 1735-50(15 Aug 1971).

The infrared spectra of gaseous, liquid, and polycrystalline symmetrical dimethylhydrazine and its deuterium analogs were recorded from 70 to 4000 cm^{-1}. The Raman spectra of the liquid and solid samples were also recorded and depolarization values measured. A comparison of the infrared and Raman spectra of the respective compounds indicates that the liquid phase consists of approximately a 69:31% mixture of gauche conformers. An assignment of the observed frequencies based on band positions, relative intensities, and isotopic shifts is presented for both molecular conformations. Although the torsional fundamentals were observed for the molecules in both the gaseous and crystalline states, the bands observed for the solids were more clearly defined and were thus employed for the barrier height calculations. The threefold methyl rotational barrier was calculated to be approximately 3.3 kcal/mole, whereas the magnitude of the barrier hindering internal rotation about the N–N bond was estimated to be 5.0 kcal/mole. (auth)

57 REACTION OF HYDROGEN ATOMS WITH C_2H_4 AND C_2D_4. Penzhorn, R. D.; Darwent, B. de B. (Catholic Univ. of America, Washington, D. C.). J. Chem. Phys.; 55: No. 4, 1508-11(15 Aug 1971).

A study of the photolysis of HI in the presence of C_2H_4 and C_2D_4 was carried out at low conversions, in the presence of large pressures of moderator, and at various temperatures. In the experiments with C_2D_4 the formation of a small percentage of HD was detected and it was found that the HD/H_2 ratio provides a very sensitive test of the presence of hot reactions. The observed rate of hydrogen formation was used to evaluate the ratio of rate constants for the following reactions: $H + HI \rightarrow H_2 + I$ and $H + C_2H_4$ or $C_2D_4 \rightarrow C_2H_5$ or C_2D_4H. The Arrhenius parameters for k_2/k_1 were found to be $0.30 \exp(-845/RT)$ and, using the previously determined value for k_1, we find $k_2 = 6.9 \pm 0.7 \times 10^{11}$ cm^3 $mole^{-1} \cdot sec^{-1}$. This value is based actually on the value of k for $H + I_2$ as determined by Sullivan and extrapolated to our conditions. C_2D_4 reacts about 10% faster than C_2H_4. (auth)

58 REACTIONS OF CCl_3 RADICALS WITH C_2H_6 AND C_2D_6. ISOTOPE EFFECT. Hautecloque, Simone (Univ., Paris). Compt. Rend., Ser. C; 272: No. 26, 2094-7(28 Jun 1971). (In French).

The rate constants and activation energies of the reactions $CCl_3 + C_2H_6$ and $CCl_3 + C_2D_6$ were measured from the study of CCl_3Br photolysis in the presence of isotopic molecules. The values $k_{C_2H_6} = 10^{14.32}\, e^{-(18100/RT)}$ and $k_{C_2D_6} = 10^{14.59}\, e^{-(19500/RT)}$ ($cm^3 \cdot mole^{-1} \cdot s^{-1}$) are obtained using $k = 10^{9.66}$ l · $mole^{-1}$ · s^{-1} for the CCl_3 radical combination as observed by De Mare and Huybrechts. This method disagrees with the evaluation of the primary isotopic effect using the Johnston semi-empirical method (France)

59 ULTRASONIC ABSORPTION IN HEAVY WATER–DIOXANE MIXTURES. Awasthi, O. N.; Rai, Gulshan; Deorani, S. C. (Univ. of Allahabad, India). J. Phys. Soc. Jap.; 31: No. 4, 1210-12(Oct 1971).

Ultrasonic absorption measurements were conducted in heavy water–dioxane mixtures over the entire composition range at six different frequencies in the range 30 to 100 Mc/s and at 25°C, using pulse techniques. The nature of the α/f^2 versus X_{HW}(mole fraction of heavy water) curve was found to be quite similar to that observed for water–dioxane mixtures. The results were analyzed in terms of a two-relaxation mechanism proposed by Hammes and Knoche. (auth)

60 REACTIONS OF O^- WITH SOME HYDROCARBONS IN THE ENERGY REGION BETWEEN ZERO AND TWO ELECTRON VOLTS. Stockdale, J. A. D.; Compton, R. N.; Reinhardt, P. W. (Oak Ridge National Lab., Tenn.). J. Mass Spectrom. Ion Phys.; 4: No. 5, 401-14(Aug 1970).

Reaction products and rates of reaction O^- ions with C_2H_2, C_2D_2, C_2H_4, C_2H_6, C_6H_6, and C_6H_6 were investigated at various points in the O^- energy range between zero and two electron volts using a pulsed source mass spectrometer method. As a corollary to the ion–molecule reaction studies, the energy dependence of primary negative ion formation by dissociative electron attachment to these molecules is presented. The absolute magnitude of the ion–molecule reaction cross sections, their dependence on O^- energy, and branching ratios and isotope effects (where these were obtained) are compared with existing theory. (auth)

61 LATTICE VIBRATIONAL SPECTRA OF UREA AND UREA-d_4. Geddes, A. L.; Bottger, G. L. (Eastman Kodak Co., Rochester, N. Y.). J. Chem. Phys.; 55: No. 4, 1990-1(15 Aug 1971).

The far-infrared and laser-Raman spectra of crystalline urea and urea-d_4 were measured. Single-crystal polarization data on urea were obtained using laser-Raman methods. Explicit assignments of the observed lattice vibrations were made. (M.C.G.)

62 FAR-INFRARED SPECTRUM AND NORMAL COORDINATE ANALYSIS OF α-METHANOL. Wong, P. T. T.; Wahlley, E. (National Research Council of Canada, Ottawa). J. Chem. Phys.; 55: No. 4, 1830-45(15 Aug 1971).

The infrared spectra of α-methanol and α-methanol-d_3 were measured in the range 400–20 cm^{-1} at 100 and 150°K. Seven intermolecular vibrations are expected and were observed. The CH_3 internal rotations were not observed. A normal coordinate analysis of the spectra was made assuming that the potential energy has the symmetry C_{2h}, that is, is independent of the position of the hydrogen atom in the hydrogen bond. The hydrogen-bond stretching force constant is 0.346 mdyn $Å^{-1}$, which is about

twice the value for the hydrogen bond in ice. This does not correlate well with the effect of hydrogen bonding on the OH stretching frequencies, nor with the dissociation energy of the dimers of methanol and water in the vapor. However, the heat of sublimation of methanol at 0°K indicates that about 8.5 kcal mole^{-1} are required to break the hydrogen bonds, compared with only 5.66 kcal mole^{-1} in ice, which is consistent with the higher force constant for methanol. (auth)

63 DECOMPOSITION OF TETRAMETHYL-2-TETRAZENE: REACTIVITY OF THE DIMETHYLAMINO RADICAL. Hoss, Wayne Paul. Lincoln, Neb.; Univ. of Nebraska (1971). 97p. University Microfilms Order No. 71-19,493.
Thesis.

The kinetics of the thermal decomposition of tetramethyl-2-tetrazene (TMT) in benzene were measured (127 to 142°C). The reaction was induced for initial concentrations of TMT greater than 0.2 M (136°). The principal products obtained from the decomposition were dimethylamine and tetramethylhydrazine. The addition of nitrobenzene depressed the rate of TMT thermolysis in benzene; however, the rate was faster in acetonitrile as solvent compared to benzene. These results are consistent with the reversible formation of a molecular complex between TMT and nitrobenzene, which is less labile than TMT itself. Dimethylamino radicals produced by the thermolysis of TMT at 136° were found to abstract benzylic hydrogen atoms moderately well. The rho-value for the hydrogen abstraction by dimethylamino radical from substituted toluenes was determined to be −1.08; and the kinetic isotope effect was 4.0. These results suggest that the dimethylamino radical is somewhat electrophilic and that there is a considerable amount of bond breaking in the transition state. (Diss. Abstr. Int., B)

64 REACTIONS OF CHLORODIFLUOROMETHANE AND DICHLOROFLUOROMETHANE WITH POTASSIUM t-BUTOXIDE IN t-BUTYL ALCOHOL AND KINETICS OF DEUTERIUM EXCHANGE OF SUBSTITUTED METHYL ACETATES. Dalsin, Philip David. Columbus, Ohio; Ohio State Univ. (1970). 166p. University Microfilms Order No. 71-17,980.
Thesis.

The reaction of chlorodifluoromethane with potassium tert-butoxide in tert-butyl alcohol gives cis and trans 1,2-di-tert-butoxy-1,2-difluoroethylene, as reported by Cleaver, as well as tri-tert-butyl orthoformate, tert-butyl di-tert-butoxyacetate and tert-butyl difluoromethyl ether. The same products, excluding the ether, are formed in the corresponding reaction of dichlorofluoromethane. The kinetics of the methoxide ion-catalyzed deuterium exchange of the α hydrogen atoms of methyl isobutyrate, methyl 2-ethylbutyrate, methyl dimethoxyacetate, methyl cyclopentanecarboxylate, methyl tetrahydrofuran-2-carboxylate, methyl 1,3-dioxolane-2-carboxylate, and methyl N-methylpyrrolidine-2-carboxylate in methanol-O-d were investigated at 35 and 60°C by an infrared technique. The second-order rate constants for esters containing α oxygen and nitrogen substituents give negative deviations from a Taft correlation. These deviations are larger than can be explained by steric or ring size effects. Methyl dimethoxyacetate and methyl 1,3-dioxolane-2-carboxylate give the largest deviations ($10^{6.24}$ and $10^{7.78}$ respectively) from the reactivity expected on the basis of inductive effects. The deviations from the Taft equation are rationalized by a consideration of lone-pair repulsion. (Diss. Abstr. Int., B)

65 MICROWAVE SPECTRUM OF IODOSTANNANE, SnH_3I. Wolf, Stephen N.; Krisher, Lawrence C.; Gsell, Ray A. (Univ. of Maryland, College Park). J. Chem. Phys.; 55: No. 5, 2106-14(1 Sep 1971).

The pure rotational spectra of seven isotopic species of the chemically unstable symmetric top molecule iodostannane, SnH_3I, were measured in the region 28.3 to 31.6 GHz, using a microwave spectrometer. Each transition ($J \rightarrow J + 1$) exhibited a complex K structure due to quadrupole coupling and centrifugal distortion. A quadrupole coupling constant $eQq = -1273 \pm 8$ MHz and centrifugal distortion constant $D_{JK} = 0.0041 \pm 0.0003$ MHz were obtained from the analysis. Rotational spectra of vibrational excited states were observed for the most abundant isotopic species. (auth)

66 HYPERFINE INTERACTION, CHEMICAL BONDING, AND ISOTOPE EFFECT IN ZnH, CdH, AND HgH MOLECULES. Knight, Lon B. Jr.; Weltner, William Jr. (Univ. of Florida, Gainesville). J. Chem. Phys.; 55: No. 5, 2061-70(1 Sep 1971).

ESR spectra of ZnH, CdH, HgH, and HgD molecules in their ground $^2\Sigma^+$ states were measured while trapped in solid argon matrices at 4°K. g tensors and hyperfine structure (hfs) constants for interaction with H, D, ^{111,113}Cd, and ^{199,201}Hg nuclei were observed. Coefficients of approximate LCAO wave functions are derived from these magnetic parameters and correlated with chemical bonding trends in the series and with the limiting united-atom model. Replacing H by D in HgH causes an increase of spin density on Hg and a decrease in $g_\perp$. This is shown to be largely due to the small decrease in interatomic distance and is discussed relative to other spectroscopic observations. (auth)

67 RELATIVE ^{14}C–^{13}C KINETIC ISOTOPE EFFECTS. Stern, Marvin J.; Vogel, P. Christian (Yeshiva Univ., New York). J. Chem. Phys.; 55: No. 5, 2007-13(1 Sep 1971).

Model-reaction calculations were used to show that relative $^{14}C-^{13}C$ kinetic isotope effects, defined as $r = \ln(k_{12}/k_{14})/\ln(k_{12}/k_{13})$, should, within the framework of the presently accepted statistical-thermodynamic theory of such effects in the harmonic approximation, generally be restricted to the range $1.8 \leq r \leq 2.0$. Significant deviations from this range may occur when the individual ^{14}C and ^{13}C kinetic isotope effects are of unusually small magnitude and/or are associated with easily detectable temperature-dependence anomalies. Reported cases of experimental values of r significantly outside the 1.8 to 2.0 range were examined with regard to the model-reaction calculations. It was concluded that, if the reported effects in four of the five such cases are real, additional complications, not considered in the basic theory as usually applied, must be operative. The results of this study are in accord with, and qualify only slightly, a conclusion reached by Bigeleisen almost two decades ago. (auth)

68 1795-A TRANSITION OF 2-METHYLPROPENE (ISOBUTENE). McDiarmid, Ruth (National Institutes of Health, Bethesda, Md.). J. Chem. Phys.; 55: No. 5, 2426-33 (1 Sep 1971).

The absorption system originating around 1795 Å in isobutene was studied in the parent compound and in three symmetrically deuterated isomers. Progressions were observed in the C=C stretch, $-CH_3$ symmetric deformation, $=CH_2$ deformation, $=CH_2$ torsion, and $-CH_3$ torsion vibrational modes. Sequences were observed in the $-CH_3$ torsion and once in the $=CH_2$ torsion. The ground- and upper-state methyl torsional potentials were calculated. The origin is tentatively identified as a false origin. The molecule is deduced to have undergone an extensive electronic change in the upper state. The transition is most probably $A_2 3p_y$ (σ^2_{CC}, b_2) ← $\pi(p_x, b_1)$. (auth)

69 HELICAL CONCEPT OF THE FINE STRUCTURE OF CELLULOSE. Ahmed, A. U.; Rapson, W. H. (Univ. of Toronto). J. Polym. Sci., Part A-1; 9: No. 8, 2299-2304(Aug 1971).

The helical concept of the fine structure of cellulose as proposed by Manley is discussed. The deuterium exchange experiments with cotton, cotton crystallites, and regenerated cellulose I, in which accessibility was determined by comparing the ratio of the infrared absorbance of the O−D peak to the O−H peak, revealed that the accessibility of cotton linters decreased on acid hydrolysis, whereas it increased on treatment with ethylamine followed by washing with water. This is in contrast to the finding of Manley, who had evaluated the accessibility by a gravimetric D_2O exchange method and had come to the conclusion that acid hydrolysis did not change the accessibility of cellulose and hence cellulose did not contain crystalline and amorphous phases but was all crystalline. On the basis of Manley's protofibril and the accessibility data obtained in this investigation, a concept of the fine structure of cellulose is proposed, in which the role of Manley's protofibril is analogous to the role of individual molecule in the fringe micellar model. This concept explains the properties of cellulose that are otherwise explainable on the currently accepted fringe micellar theory. In addition, it explains the marked shrinkage in the length of cotton and rayon fibers when placed in 16% sodium hydroxide solution. (auth)

70 POLARIZED VIBRATIONAL SPECTRA OF POTASSIUM CHLORATE. Bates, John B. (Oak Ridge National Lab., Tenn.). J. Chem. Phys.; 55: No. 2, 494-503(15 Jul 1971).

The Raman spectra of single crystal $KClO_3$ were measured in the region above 30 cm^{-1} at 298 and 77°K. Single crystal infrared spectra in the internal mode region were measured by reflection at 298°K. Infrared spectra of the polycrystalline material also were measured at 77°K. Assignments for all of the crystal vibrations that are derived from correlation field splitting of the (internal) ClO_3^- vibrations were made from the results of the polarization measurements. Longitudinal optical mode frequencies for the $\nu_3(B_u)$ and $\nu_3(A_u)$ components obtained from polarized (infrared) specular reflection measurements on polycrystalline $KClO_3$ are also reported. The bands due to the Raman active lattice modes were observed in the region below 200 cm^{-1} and were tentatively assigned to librational or to translatory-type motions. The 2-cm^{-1} splitting observed for the ν_1 mode of the $^{35}Cl^{18}O^{16}O_2$ and $^{37}Cl^{18}O^{16}O_2$ isotopes in the low-temperature Raman spectra was assigned to an orientational effect in the lattice. (auth)

71 ELECTRON PARAMAGNETIC RESONANCE ABSORPTION IN ORIENTED PHOSPHORESCENT TRIPHENYLENE-h_{12} AND TRIPHENYLENE-d_{12} FROM 4 TO 250°K. Gerkin, Roger E.; Szerenyi, Peter (Ohio State Univ., Columbus). J. Chem. Phys.; 55: No. 5, 2575-92(1 Sep 1971).

Electron paramagnetic resonance absorption by phosphorescent triphenylene-h_{12} and -d_{12} oriented in single crystals of symmetric dodecahydrotriphenylene was investigated in the temperature range from 4 to 250°K. Both guest molecules are multiply oriented in this host. In addition, two distinct kinds of mixed crystals were identified on the basis of the zero-field splittings manifested by the guest molecules. In one kind of mixed crystal, guest splittings were found to change with time until stable, fixed values were established. Since splitting differences are related to orientational differences, guest rearrangement in the solid host is implied, which has not heretofore been reported. The temperature dependence of at least one zero-field splitting parameter D is complex in that its magnitude does not increase monotonically with decreasing temperature. The temperature dependences of the zero-field splitting parameters E are even more complex. X-ray diffraction data indicate that both kinds of mixed crystals have the same overall host structure and are free from disorder. The unit cell deviates slightly from the previously reported hexagonal type, indicating lower than threefold site symmetry. Because of this, and also because of the multiple orientation, the E parameters of the triplet guests cannot be expected to vanish. The data provide some evidence that the entire magnitude of E is due to the molecular-crystal field. The decays of the resonance absorptions of both guests were investigated as functions of temperature, and the angular dependence of the resonance absorption linewidths for triphenylene-d_{12} was studied near 77°K. The wave function of the lowest triplet state of trigonal triphenylene, and its energy relative to the ground state, were calculated in the Pariser–Parr–Pople approximation. The zero-field splitting parameter D was calculated using two-center integrals evaluated by the Gaussian-transform method. The calculated values of both the energy and D are in very good agreement with experimental values. (auth)

72 FRIEDEL–CRAFTS ISOPROPYLATION IN NONPOLAR SOLVENTS. Nakane, Ryohei; Kurihara, Osamu; Takematsu, Akiko (Inst. of Physical and Chemical Research, Saitama, Japan). J. Org. Chem.; 36: No. 19, 2753-6(24 Sep 1971).

Competitive boron trifluoride catalyzed isopropylations of benzene and toluene with isopropyl fluoride in nonpolar organic solvents were carried out at −23, 0, and 25°. The relative rates of toluene to benzene were always smaller than 1. The isopropylations were accelerated by a trace of water. The isopropylations of benzene-d_6 and toluene-d_8 at 25° showed small secondary inverse kinetic isotope effects. These results suggest that an alkylation catalyst is a hydrate of boron trifluoride, that an electrophile in isopropylation is an isopropyl carbonium ion or its ion pair, that the rate-determining transition state formed in the substitution of toluene closely resembles the oriented π complex, and that the difference in rates between benzene and toluene is due primarily to the difference in the entropies of activation, which can be negative, when the difference in the activation energies between both aromatics is very small. (auth)

Physical Chemistry

Refer also to abstracts 147, 412, 652, and 710.

73 (AI-AEC-12818, pp 19-25) HIGH TEMPERATURE CHEMISTRY. (Atomics International, Canoga Park, Calif.). Jan–Mar 1969.

In AEC unclassified programs.

Research progress is reported on fused salts and metal–metal salt solutions. The density and compressibility of $AlCl_3$ were studied, along with the electric conductivity of $HgCl_2$ and HgI at high pressures. Oxide species in molten nitrates and thermodynamics of liquid alloys are being investigated. (M.C.G.)

74 (AI-AEC-12860, pp 27-36) HIGH TEMPERATURE CHEMISTRY. (Atomics International, Canoga Park, Calif.). 1969.

In AEC unclassified programs.

Progress in research on fused salts and metal–metal salt solutions is reported. Details of some of the studies have been published. A study of the effects of pressure on the volume of fusion and compressibility of $AlCl_3$ was completed. The high increase of volume on fusion at 1 atm (85%) was reduced to about 4% at 30 kbar. Application of 10 kbar pressure decreased the specific conductance of $AlCl_3$ from 10^{-7} to 10^{-9} (ohm-cm)$^{-1}$. Application of pressure was found to increase the conductivity of $HgCl_2$, HgI_2, and $HgBr_2$. Application of pressure to molten HgI_2 results in its behaving as a normal salt with a positive temperature coefficient of conductivity. Studies of the emf measurements on two ternary fused salt systems, CsCl–NaCl–$PbCl_2$ and CsCl–KCl–$PbCl_2$, indicated nonrandom mixing of nearest neighbor cations. Results of calculations of pressure–volume data for water up to a pressure of 165 kbars are in disagreement with those obtained from shock-wave data. (J.G.B.)

75 (FRNC-TH-89) STUDY OF SOME 4f AND 5f ELEMENTS BY RADIOCHEMICAL POLAROGRAPHY. Dautet, Daniele (Paris Univ., Orsay (France)). 1971. 36p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The classical polarography method and the results obtained using this method in the study of 4f and 5f elements are reviewed. Radiochemical polarography is then presented and compared to the usual method. The study of some 4f and 5f elements (Ce, ^{153}Sm, ^{155}Eu, Gd, ^{160}Tb, Ho, ^{169}Yb, Lu and ^{228}Ac, ^{241}Am, ^{244}Cm, ^{252}Cf) by radiochemical polarography revealed that all the elements were reduced in the divalent state in an intermediate step during the formation of their amalgam. With Gd, Ac, Am, Cm, and Cf, direct information was obtained on the existence of an M^{II} state and the half-wave M^{2+}–M(Hg) potentials. On the contrary, the polarograms found for the other elements indicated a more complex reduction mechanism due to localized hydrolysis phenomena. (France)

76 (TID-25803) PROGRESS REPORT [ON PHYSICAL CHEMISTRY], OCTOBER 1, 1969–SEPTEMBER 30, 1970. White, David (Pennsylvania Univ., Philadelphia. Dept. of Chemistry). Contract AT(30-1)-3783. 51p. Dep. NTIS.

The difference in vapor pressure between equilibrium deuterium (2.15% para) and solutions of higher para composition was measured as a function of temperature for the liquid. Several measurements in the solid state are also reported. From purely thermodynamic considerations it was found that all the excess functions can be derived from the measurements as well as the ratio of fugacities of the pure components. The statistical mechanical treatment of Bablyontz and Bellemans (Mol. Phys 3, 313 (1960)) was used to account for the nonidealities of the ortho–para solutions and to obtain parameters of both the angular dependent electric quadrupole–quadrupole interactions and the isotropic interactions represented by the Lennard--Jones function. (auth)

77 $Np(MoO_4)_2$–$NaMoO_4$ SYSTEM: IDENTIFICATION OF THE $Na_4Np(MoO_4)_4$ AND $Na_2Np(MoO_4)_3$ PHASES OF SCHEELITE TYPE. Freundlich, W.; Pages, M. (Univ., Paris). Compt. Rend., Ser. C: 273: No. 1, 44-6(5 Jul 1971). (In French).

The study of the neptunium molybdate–sodium molybdate system by differential thermal microanalysis and x-ray diffraction revealed two new phases: $Na_2Np(MoO_4)_3$ and $Na_4Np(MoO_4)_4$. These two compounds present a noncongruent fusion. (France)

78 SPECTRAL AND MAGNETIC STUDIES ON URANYL(VI) COMPLEX OF 7-HYDROXY-4-METHYLCOUMARIN-6-CARBOXYLIC ACID. Rastogi, D.K. (Meerut Coll., India). Curr. Sci. (India); 40: No. 15, 396-8(5 Aug 1971).

A study was made of the light grayish-buff-colored complex formed by the reaction of uranyl ions with 7-hydroxy-4-methylcoumarin-6-carboxylic acid (7-hydroxy-4-methyl-2-oxo-2H-1-benzopyran-6-carboxylic acid). Magnetic measurements reveal an anomalous magnetic behavior (μ_{eff} 0.67 B.M.) that is due to temperature-independent paramagnetism. Infrared spectral studies indicate the essentially ionic character of metal–oxygen bond. (D.H.M.)

79 TWO NEW Np(VII) COMPOUNDS: K_3NpO_5 AND Rb_3NpO_5. Pages, Monique; Nectoux, Francoise; Freundlich, William (Univ., Paris). Compt. Rend., Ser. C: 272: No. 24, 1968-70(14 Jun 1971). (In French).

The Np(VII) compounds, K_3NpO_5 and Rb_3NpO_5, were prepared by the reaction of an alkali peroxide, MO_2, on NpO_2. Their thermolysis produced an unknown tetragonal Np(VI) phase, isotypic of M_2UO_4: M_2NpO_4. (France)

80 ESTIMATED FREE ENERGIES OF FORMATION OF $PaCl_4$, $PaBr_4$, AND PaF_4, AND ACTIVITY COEFFICIENTS FOR PROTACTINIUM IN LIQUID BISMUTH SOLUTIONS. Ferris, L. M. (Oak Ridge National Lab., Tenn.). Inorg. Nucl. Chem. Lett.; 7: No. 9, 791-9(Sep 1971).

Standard free energies of formation of solid $PaCl_4$ were found to be given by $\Delta G^f_{PaCl_4(S)}$ (cal/mole) = −270,000 + 119T − 16T log T, with an estimated uncertainty of ±3,000 cal/mole; this gives −204 kcal/mole at 913°K. For $\Delta G^f_{PaBr_4}$ the average value was −173 ± 8.5 kcal/mole at 913°K. For $\Delta G^f_{PaF_4(S)}$ values were given by −480,000 + 117.3T − 15T log T, with an estimated uncertainty of ±4000 cal/mole; these values are tabulated for various tempera-

tures, and are consistent with a value of -482 ± 6 kcal/mole at 298°K, and -414 kcal/mole at 913°K. Measurements were also made, over the range 873 to 1023°K, of the equilibrium distribution of Pa between molten lithium halides and liquid Bi solutions, and expressions for the equilibrium constant and distribution coefficients are given. Expressions are also derived that give the activity coefficients for Pa in infinitely dilute liquid Bi solution between 873 and 973°K. (UK)

Radiation and Nuclear Chemistry

81 (RRL-2310-349) QUARTERLY REPORT, APRIL 1, 1971-JUNE 30, 1971. Fundamental Research No. 6041. (Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.). 8 Jul 1971. 19p. Dep. NTIS.

Abstracts of reports issued during the quarter are presented, and descriptions are given of other investigations in radiation chemistry now in progress. (D.H.M.)

Radiation Effects

82 ANNEALING OF CHEMICAL RADIATION DAMAGE IN LITHIUM AND CESIUM BROMATES. Dube, J. S.; Mohanty, S. R. (Utkal Univ., Bhubaneswar, India). Radiochim. Acta; 16: No. 1, 46-9(Aug 1971).

The kinetics of thermal annealing of bromite and hypobromite in γ-irradiated lithium bromate and of oxidizing fragments in γ-irradiated cesium bromate were studied. The annealing of bromite is a combination of a first order and a second order process whereas the annealing of oxidizing fragments is represented by the combination of two first order and one second order reaction. (auth)

83 CONTRIBUTION TO THE RADIATION TECHNOLOGY OF NATURAL CELLULOSE. Luethy, H. (Buergerspital, Basel. Univ., Basel). Atomkernenergie; 18: No. 2, 93-6(1971). (In German).

When subjected to gamma radiation, cellulose is degraded with a corresponding decrease in the degree of polymerization. This effect becomes measurable through a decrease of intrinsic viscosity. The 30% $(Cd(en)_3)(OH)_2$ was used as a suitable solvent for extracted carrot cellulose. The theoretically deduced relation between intrinsic viscosity $[\eta]$ and radiation dose D, $\log [\eta] = -\alpha \log [D + D_0] +$ constant, was experimentally verified. The value of α is in excellent agreement with those obtained by other authors. The so called virtual dose D_0, needed to produce the initial number-average molecular weight, is inversely proportional to the degree of polymerization. This value, experimentally evaluated with only one radiation exposure in the range of 10^7 to 10^8 R, varies for cellulose of different origins; it may be a useful parameter in radiation technology of cellulose containing materials. (auth)

84 STUDIES ON THE MANUFACTURE OF LOW DP PULPS BY IRRADIATION. 2. ELECTRON SPIN RESONANCE AND POST EFFECTS IN IRRADIATED PULPS. Ueno, Takeo (Sanyo Pulp Co. Ltd., Iwakuni, Japan); Yamauchi, Tatsuo; Imamura, Rikizo. Kami Pa Gikyoshi; 25: No. 5, 242-9(May 1971). (In Japanese).

The free radicals formed in the irradiated pulps and the after-effect of irradiation (that is, post-irradiation depolymerization) were investigated. The degree of polymerization (DP) of gamma-irradiated pulps progressively reduces up to a few weeks in air at 20°C, but with heat treatment this period is shortened, for example, with only 15 hours of heat treatment at 60°C, DP of pulps settles down to a definite level. Also radicals formed by irradiation, detected and determined by electron spin resonance (ESR), decay very slowly at 20°C, but heat treatment increases this decaying speed. Although the decrement of radicals and the reduction of DP change in the similar tendency at relatively low temperature, the latter exceeds the former at above 100°C. Therefore, it may be said that, at high temperature, main chain scissions that are independent of the decay of radiation-induced radicals take place in pulps. However, this phenomenon occurs as well in original pulps. Heat treatment has negligible effect on the analytical properties of low DP pulps except that the higher the temperature, the more copper number. On the other hand, "true" carbonyl groups estimated by chelatometric titration method after oxidizing to carboxyl are unchanged. This fact shows that alkali sensitivity of pulps which has been given by irradiation becomes much greater by heat treatment. (auth) (Japan)

85 IDENTIFICATION OF IONIC PRODUCTS AND MECHANISMS OF CHARGE TRANSPORT IN IRRADIATED 3-METHYLPENTANE IN THE TEMPERATURE RANGE 77 TO 130°K. Dietrich, Bruce Keller Madison, Wis.; Univ. of Wisconsin, Madison (1971). 207p. University Microfilms Order No. 71-16,070. Thesis.

The identity and properties of trapped charged species produced by irradiation of nonpolar organic glasses were investigated. This was done by studying the electric conductivity of unirradiated and irradiated 3-methylpentane (3MP) as a function of temperature in the presence and absence of electron scavengers and positive charge scavengers, and after ir and uv photobleaching. Ions were produced in 3MP glasses at 77°K by irradiation with ^{60}Co γ rays, by photoionization of a dissolved aromatic amine, and by self-irradiation with the beta particles from tritium incorporated in 3MP molecules. For γ-irradiated 3MP, the radiation-induced portion of the current spike at 77°K is postulated to be due to RH_2^+ ions that can move through the glass at 77°K by proton transfer. Following decay of the current spike, a positive current peak appears at 85°K in the warmup conductivity curve of irradiated 3MP. The radiation-induced current in tritiated 3MP is nearly independent of temperature between 77°K and 100°K, increasing by a factor of 2.5. The current in this region is attributed to mobile electrons and positive holes. Above 100°K the current increases rapidly with temperature, increasing by a factor of 10 between 100°K and 125°K. The area of the warmup conductivity curve following photoionization of N, N, N′, N′-tetramethyl-p-phenylenediamine in 3MP glass containing alkyl halides varies with different halides and alkyl groups in the same manner as do the radical yields from dissociative electron capture in the same system. (TSS)

86 ELECTRON SPIN RESONANCE OF γ-IRRADIATED DICYANDIAMIDE. Lind, G.; Kewley, R. (Queen's Univ., Kingston, Ont.). Can. J. Chem.; 49: 2514-23(1 Aug 1971).

The X-band ESR spectra of single crystal and powder samples of γ-irradiated dicyandiamide, $(H_2N)_2CNCN$, were observed. The results show that three radical species are formed on irradiation at room temperature. One of these radicals, which gives a single broad line spectrum of width 8.5 G and g = 2.0040, was not identified. The other two species are considered both to have the same chemical formula $NH_2C(NH)NCN$ but one is a π-electron radical whereas the other is a σ-electron radical with a very large proton hyperfine splitting in the range of 73 to 81 G. The production of two types of radicals by radiation damage to the same—NH_2 group of dicyandiamide is explained in terms of the ease of formation of π- and σ-electron radicals as influenced by geometrical considerations stemming from the hydrogen bonding in the dicyandiamide crystal. (auth) (Canada)

87 ELECTRON PARAMAGNETIC RESONANCE OF FREE RADICALS IN AN ADAMANTANE MATRIX. III. ISOCYANATOALKYL AND ISOTHIOCYANATOALKYL RADICALS. Wood, David E.; Lloyd, Roger V.; Lathan, William A. (Carnegie-Mellon Univ., Pittsburgh). J. Amer. Chem. Soc.; 93: No. 17, 4145-8 (25 Aug 1971).

Several members of the previously unknown class of isocyanatoalkyl and isothiocyanatoalkyl radicals have been prepared and studied by EPR by use of the adamantane matrix technique. Typical parameters for these radicals are exemplified by the results for isocyanatoethyl radical, $CH_3\dot{C}HNCO$, with $a_H^\alpha = 21.1$, $a_H^\beta = 21.1$, $a_N = 4.2$ G, and $g = 2.0026$; and for the sulfur analog, $CH_3\dot{C}HNCS$, with $a_H^\alpha = 18.6$, $a_H^\beta = 18.6$, $a_N = 5.6$ G, and $g = 2.0030$. These radicals were obtained by the room-temperature x-irradiation of ethyl isocyanate and ethyl isothiocyanate trapped in adamantane. The corresponding radicals from propyl, isopropyl, butyl, and cyclopentyl isocyanates and isothiocyanates (except cyclopentyl isothiocyanate) were similarly obtained and their EPR spectral parameters are reported herein. INDO and STO-3G calculations predict linear and bent planar structures, respectively, for the isocyanatomethyl radical, and the EPR results are consistent with both structures or, as is more likely, with rapid interconversion. However, distortions from planarity are ruled out by lack of temperature dependencies of the α-proton and nitrogen hyperfine splittings and by INDO calculations on the nonplanar forms. (auth)

88 ESR STUDY OF RADICALS FORMED BY γ IRRADIATION OF K_2PdCl_4 AND $(NH_4)_2PdCl_4$ SINGLE CRYSTALS. Krigas, Thomas; Rogers, Max T. (Michigan State Univ., East Lansing). J. Chem. Phys.; 54: No. 11, 4769-75(1 Jun 1971).

An X-band ESR study of γ-irradiated single crystals of K_2PdCl_4 and $(NH_4)_2PdCl_4$ was made at 77°K. Two radicals are observed, one of which is shown to be $PdCl_4^{3-}$ with a $4d^9$ configuration and $d_{x^2-y^2}$ ground state; the complete g, A (^{105}Pd) and A (^{35}Cl) tensors have been reported for this species. The second radical is believed to be $PdCl_5^{2-}$, and its ESR parameters are presented and discussed. (auth)

Radiation Processes

89 (COO-2057-1) INVESTIGATION OF THE RADIATION POLYMERIZATION OF METHYL METHACRYLATE–KAOLIN CLAY COMPOSITES. Final Report. Mayhan, K. G.; Beeson, J. J. (Missouri Univ., Rolla). 2 Aug 1971. Contract AT(11-1)-2057. 142p. Dep. NTIS.

A kinetic and characterization study was made on the effects of gamma rays (^{60}Co) on the polymerization of a 50–50 weight mixture methyl methacrylate (MMA) kaolin clay system. The effects of dose rate (7.35 to 24.9 rads per second), temperature (25 to 75°C), and total dose on the percentage conversion of monomer to polymer were studied. The rate of formation of polymer at 25°C in the composite system was found to be faster when compared to a bulk MMA system at the same experimental conditions. This acceleration showed that the clay had a catalytic effect on the formation of polymer. The effect decreased as temperature increased. Rate data and apparent activation energies are reported. Two types of poly(methyl methacrylate) (PMMA) were formed in the composite. One type was called homopolymer and could be removed from the composite by extraction with organic solvents. The other type was called inserted polymer and could only be removed by dissolving the clay matrix with hydrofluoric acid. NMR spectra showed that both polymers had increased isotacticity as compared to bulk polymer. The viscosity average molecular weights of the homopolymer ranged from (0.4×10^6 to 5×10^6) depending on the dose rate, temperature, and total dose received. Gel permeation chromatography studies confirmed the increase of molecular weight for the homopolymer and showed the same peak molecular weights and distribution for the inserted polymer. Infrared spectroscopy showed no differences in the structure of either type of polymer. X-ray, particle size gravimetric thermal analysis (DTA-TGA), and surface area measurements were used to characterize the clay. Mechanical tests, DTA-TGA, and scanning electron microscopy were used to characterize the entire composite. A discussion on the potential uses of PMMA-kaolin clay composites is presented along with suggested future work in this area of research. (auth)

90 (N-71-26030) RADIATION-INDUCED PREPARATION OF ANTIMONY FROM SOLUTIONS OF ANTIMONY(III) CHLORIDE IN ORGANIC LIQUIDS. Philipp, Warren H.; Marsik, Stanley J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1971. 10p. (NASA-TN-D-6358). NTIS.

The yield of antimony metal (Sb) from the irradiation with 2-MeV electrons of antimony(III) chloride solutions in a variety of anhydrous organic liquids is presented. The yield of atoms of Sb per 100 eV multiplied by the valence change n = 3 ranged from 0 to 3.71; the product contained from 85 to 99.9+ % Sb. Best yields and highest Sb purity were obtained from primary alcohols. For the two liquids tested, the yield increased with antimony(III) chloride concentration. The application of anhydrous organic systems to the deposition of metals in general is briefly discussed. (auth) (STAR)

91 FLOW RATE AND DECONTAMINATION FACTOR OF ^{137}Cs AND ^{131}I THROUGH MIXED RESIN BED. Yokotsuka, Seiichiro (Mitsubishi Chemical Industry Co. Ltd., Yokohama, Japan); Akatsu, Eiko; Ueno, Kaoru. J. Nucl. Sci. Technol. (Tokyo); 8: No. 9, 477-80(Sep 1971).

Aqueous solutions of ^{131}I and of ^{137}Cs were passed through an ion exchange resin column. The resin bed consisted of a 2:1 mixture of cation and anion exchange resins, Diaion SKN-1 in H form and Diaion SAN-1 in OH form. The decontamination factors for these radioisotopes were determined at various flow rates, i.e., space velocities of 25 to 200. The decontamination factor decreased with increasing flow rate for both radioisotopes. The Kd value of ^{137}Cs between Diaion SKN-1 and water was about half that of ^{131}I between Diaion SAN-1 and water, but D.F. of ^{137}Cs was higher. Distribution of ^{137}Cs in the resin column was also studied. Most of radioactivity was found at the top of the resin column. (auth)

92 ELECTRODEPOSITION AND RADIATION CURING OF COATINGS. Ranney, M. W. Chemical Process Reviews. Park Ridge, N. J.; Noyes Data Corporation (1970). 175p. $35.00.

Detailed and descriptive information based on U. S. patents relating to techniques and formulations for electrodeposition and radiation curing of organic coatings is presented. The discussion on electrodeposition includes chapters entitled Process Equipment and Techniques, Coating Formulations, and General Techniques. Chapter titles in the section on radiation curing are Coating Formulations and Process Equipment. Company, inventor, and U. S. patent number indexes are included. (J.G.B.)

93 RADIOLYTIC SCISSION IN STRESSED POLYDIMETHYLSILOXANE NETWORKS. Tanny, Gerald Brian. Montreal; McGill Univ. (1970). National Library of Canada, Ottawa. Thesis.

An investigation was made of SiO bond scission caused by γ rays in elastomeric poly (dimethylsiloxane), (PDMS), networks subjected to stress. The results established the G values for scission under these conditions and a mechanism is proposed to explain the observed behavior. A detailed study of the irradiation products of octamethyltrisiloxane is reported. These results were used to support mechanistic ideas developed from stress relaxation experiments. The discovery that cyclic molecules are evolved from the radiolysis of linear siloxanes was also reported. The stress relaxation behavior of silica filled PDMS networks exposed to γ radiation is described in detail. Enhanced scission yields are described in relation to filler content, particle size, and irradiation temperature. The nature of "energy transfer" from the filler particles to the polymer chains at the filler surface is discussed and a mathematical analysis of the proposed mechanism is undertaken. Filler agglomeration within the composite was determined by photomicroscopy and the distribution was related to the profile of G(scission) versus filler content. (Diss. Abstr. Int., B)

94 RADIATION-INDUCED PARTIAL OXIDATION OF CYCLOHEXANE. I. EFFECT OF TEMPERATURE. Guetlbauer, F. (Reaktorzentrum, Seibersdorf, Austria); Hardung-Hardung, H.; Hofmann, Hd.; Corsepius, H.; Proksch, E. Atomkernenergie; 18: No. 2, 165-71(1971).

The effects of ionizing radiation on the oxidation of cyclohexane by air or oxygen at dose rates up to 540 krad/h was studied statically and dynamically within a temperature range of 125 to 190°C. In comparison to a pure thermal reaction, the formation of cyclohexanol and cyclohexanone increases in a static oxidation reaction in glass vessels using atmospheric oxygen as well as in dynamic oxidation tests in a one-phase liquid reactor employing pressure-dissolved oxygen (60 atm/gauge) approximately by the factor 6 in the event of γ-irradiation at 125°C. At this temperature, the G-value is 50 for radioinduced formation of the above products, which represents the increase over formation by pure thermal reaction. At higher temperatures the ratio between radiation-chemical yield and thermal conversion drops, but the difference between the two values increases, nevertheless, and the G-value of cyclohexanol and cyclohexanone formation exceeds 250 at a temperature of 160°C. In contrast to a pure thermal reaction, an induction period is missing in a radiation-chemical oxidation process and undesirable secondary products, in particular dicyclohexyl form in substantial quantities only if free oxygen is lacking during irradiation. Static tests which were carried out to investigate radiation-chemical decomposition of ca 5% cyclohexanol and cyclohexanone solutions in cyclohexane during depletion in oxygen, revealed that mainly cyclohexanone of G-values up to ca 200 at 135°C continues to react while the cyclohexanol is hardly affected. Conversion rates of radiation-chemical oxidation in the gas phase are throughout lower than those obtained in the liquid phase; the G-value of cyclohexanol and cyclohexanone rises from 7.8 at 110°C to ca 28 at 164°C. (auth)

95 GAMMA RADIATION SOURCE AND METHOD FOR THE TREATMENT OF SEWAGE. Miraldi, Floro D.; Morgan, Edward J. U. S. Patent 3,603,788. 7 Sep 1971. Filed 6 May 1968.

A method is disclosed for the treatment of contaminated water (sewage) by the gamma rays from fission byproduct waste so as to kill bacteria and/or degrade chemical waste in the contaminated water. The fission byproduct waste is encapsulated in a leach-resistant glass or ceramic product to form a radiation source. The radiation source is held by a holder inside a casing containing coolant. The source, holder, casing, and coolant form a natural convection cell for the dissipation of heat. The casing and contents form radiation cells which may be interlocked into rows to form channels. The rows of cells may be fitted with guide vanes to give a generally helical motion and mixing of the contaminated water so as to ensure uniform irradiation of the water. The channels may be cleaned by high-velocity water jets. As a result, a treatment plant may be designed and built so that sewage receives at least 0.14 megarad of radiation, which is sufficient to kill at least 99.99% of the Escherichia coli bacteria, degrade many chemical compounds, especially the benzyl sulfonate detergents, and accelerate sedimentation. (auth)

96 RADIATION-INDUCED OXIDATION OF 2-PROPANOL BY HYDROGEN PEROXIDE IN AQUEOUS SOLUTIONS. Burchill, C. E.; Ginns, I. S. (Univ. of Manitoba, Winnipeg). Can. J. Chem.; 48: No. 8, 1232-8(15 Apr 1970).

The radiation-induced oxidation of 2-propanol by hydrogen per-

oxide in neutral deaerated aqueous solution was investigated. 2-Propanol is oxidized to acetone, and hydrogen peroxide reduced in stoichiometrically equivalent high yields. The yields are independent of hydrogen peroxide concentration in the range 5×10^{-2} to 10^{-3} M and linearly dependent on alcohol concentration in the range 0.13 to 1.05 M. The reaction yields increased with decreasing dose rate. The results are explained by a chain mechanism in which initiation occurs via H-atom abstraction from 2-propanol to form either $(CH_3)_2\dot{C}OH$(1) or CH_3 CHOH $\dot{C}H_2$(2). 1 reacts with H_2O_2 in a chain propagating reaction. 1+ H_2O_2 → acetone + H_2O + OH 2 may abstract the α hydrogen from the parent alcohol 2 + 2-propanol → 2-propanol + 1 or undergo bimolecular termination. A lower limit of 53 ± 101 mole^{-1} s^{-1} is estimated for the rate constant for this radical conversion reaction. (auth) (Canada)

97 END-GROUP ORIENTATION IN CRYSTALLINE POLYOXYMETHYLENE. Kitagawa, Teizo (Osaka Univ.); Tanaka, Akira; Nishii, Masanobu. J. Polym. Sci., Part B; 9: No. 8, 579-82(Aug 1971).

Spectroscopic evidence concerning orientation of chain end-groups was obtained on crystalline polyoxymethylene obtained by radioinduced solid-state polymerization of single crystal tetraoxane $(CH_2O)_4$. The chain axis (c) of the polyoxymethylene crystal was confirmed by x-ray diffraction to be parallel to the b axis of tetraoxane (C^5_{2h} – C2/c). The molecular weight was determined to be 8×10^4. (D.H.M.)

98 FREE IONIC POLYMERIZATION OF ISOBUTYL VINYL ETHER BY RADIATION. Hayashi, Kanae; Hayashi, Koichiro; Okamura, Seizo (Japan Atomic Energy Research Inst., Neyagawa City, Japan). J. Polym. Sci., Part A-1; 9: No. 8, 2305-21(Aug 1971).

Radiation-induced free-ionic polymerization of isobutyl vinyl ether in a bulk system was studied by dilatometry and electric conductivity measurement. Some refinements in kinetic treatment to estimate the propagation rate constant k_p from the rate of polymerization and steady-state conductivity were attempted. Polymerization of superdried monomer which gave a half-power dose-rate dependence of R_p was carried out at 0, 25, and 50°C. The k_p value obtained at 25°C and an activation energy for propagation were estimated as $1.2 \pm 0.4 \times 10^5$ l/mole-sec and 9.6 ± 2.8 kcal/mole, respectively. In isobutyl vinyl ether, a propagation reaction in free-ionic mechanism was found to be characterized with a high frequency factor and presumably higher activation energy, compared with ion-pair mechanism. Discussions were also made as to several contrasting behaviors between the polymerization of alkyl vinyl ethers and other vinyl monomers as styrene both in free-ion and ion-pair mechanisms. (auth)

99 EFFECT OF CRYSTALLINITY ON RADIATION-INDUCED GRAFT COPOLYMERIZATION ON CELLULOSE. Ahmed, A. U.; Rapson, W. H. (Univ. of Toronto). J. Polym. Sci., Part A 1; 9: No. 8, 2129-36(Aug 1971).

With vinyl monomers, viz., styrene, butyl methacrylate, dimethylaminoethyl methacrylate, and ethyl acrylate, it was noted that higher per cent grafting was obtained with "recrystallized" cellulose than with "amorphous" cellulose. The possibility of the production of a porous structure in cellulose as a result of γ-irradiation followed by the dissolution of the reactive regions is suggested. DTA and DTG data of irradiated cellulose triacetate (CTA) reveal lowering of the melting point on irradiation, indicating a decrease in crystallinity. Decrease in density of cellulose on irradiation by γ-rays also indicates loosening of the structure of cellulose. It is postulated that grafting occurs in those regions of cellulose which were crystalline before irradiation, as well as in less crystalline regions. (auth)

100 RADIATION-INITIATED HOMOGENEOUS GRAFTING OF STYRENE TO BENZYLCELLULOSE. Betty, R. W.; Rapson, W. H. (Univ. of Toronto). J. Polym. Sci., Part A-1; 9: No. 7, 1901-19(Jul 1971).

Graft copolymers of benzyl cellulose and styrene were prepared by direct irradiation of benzyl cellulose–styrene solutions with ^{60}Co γ radiation. The solutions remained homogeneous during irradiation. The amount of styrene grafted to benzyl cellulose increased in dilute solutions and was dose-dependent up to 4.0 MR. The graft copolymer consisted of both branched and linear structures with one in every 140 to 1020 benzylated anhydroglucose units carrying a grafted polystyrene chain. Grafted polystyrene was isolated from the graft copolymer by hydrolysis of the benzyl cellulose substrate. The number-average molecular weight and molecular weight distribution of the grafted polystyrene were the same as those for homopolymer formed in the same solution, indicating that the substrate is fully accessible to the monomer and polymerization conditions are uniform throughout the solution during the grafting procedure. The existence of a true graft copolymer was proved by the solubility behavior, intrinsic viscosity, number-average molecular weight, and density-gradient sedimentation of the product of the grafting procedure. Column elution fractionation of the gross products of the grafting procedure failed to isolate the benzyl cellulose–styrene copolymer which was eluted with ungrafted benzyl cellulose. (auth)

101 RADIATION-INDUCED POLYMERIZATION AT HIGH PRESSURE OF 2,3,3,3-TETRAFLUOROPROPENE IN BULK AND WITH TETRAFLUOROETHYLENE. Brown, Daniel W.; Lowry, Robert E.; Wall, Leo A. (National Bureau of Standards, Washington, D. C.). J. Polym. Sci., Part A-1; 9: No. 7, 1999-2007 (Jul 1971).

The radiation-induced polymerization of 2,3,3,3-tetrafluoropropene was studied as a function of temperature (22 to 100°C) and pressure (autogenous to 10^4 atm). Rates have varied 100-fold for the same reaction conditions probably because of trace impurities. The most rapidly polymerizing material has a rate of 4.5% 1 hr at 6000 atm, 22°C, and 1500 rad/hr. The activation enthalpy and volume are 4 kcal/mole and –13 cc/mole, respectively. Rates are proportional to the square root of the radiation intensity. Degrees of polymerization varied between 2×10^3 and 2×10^6. In copolymerization with tetrafluoroethylene the reactivity at 22°C and 5000 atm are 0.37 (the ratio for addition to the tetrafluoroethylene-ended radical) and 5.4 (the ratio for addition to the tetrafluoropropene-ended radical). Comparison of ratios for the copolymerization of other fluorine-containing monomers with tetrafluoroethylene shows that they generally disfavor incorporation of the latter. (auth)

102 γ-RAY-INDUCED POLYMERIZATION OF α-HALOACRYLIC ACIDS. Watanabe, Haruhiko; Murano, Masao (Toyobo Co. Ltd., Otsu, Japan). J. Polym. Sci., Part A-1; 9: No. 4, 911-18(Apr 1971).

The γ-induced polymerizations of α-chloroacrylic acid, mp 66°C, and α-bromoacrylic acid, mp 72°C, were investigated in the temperature range from 35 to 85°C. An analysis of polymerization kinetics was made, and results were similar to those reported in the literature for other vinyl monomers. On heating of the polymer obtained, elimination of hydrogen halide takes place, and intramolecular lactone formation is observed. The rate of lactone formation of poly(α-chloroacrylic acid) obtained in the solid-state polymerization was found to be higher than that in the liquid state, because a highly isotactic configuration of polymers tends to be formed in the solid-state polymerization, and elimination of hydrogen chloride is facilitated with an isotactic 5_2 helix structure. (auth)

103 RADIATION CHLORINATION OF 1,1,1,5-TETRACHLOROPENTANE. Lebedev, D. D.; Vereshchinskii, I. V. (Inst. of Physical Chemistry, Moscow). This paper was summarized in Khim. Vys. Energ.; 3: No. 3, 267(May-Jun 1969). (In Russian).

Full copy of this paper is held by DTIE.

A study of the liquid-phase radiation chlorination of 1, 1, 1, 5-tetrachloropentane showed that exposure to the action of ionizing radiation leads to a sharp increase in the rate of chlorination of hexa-, hepta-, octa-, and nonachloropentane. Decachloropentane is not formed except under the action of radiation. (D.H.M.)

Radiolysis

Refer also to abstracts 390, 391, 411–413, and 1548.

104 (AI-AEC-12818, pp 27-30) RADIATION CHEMISTRY. (Atomics International, Canoga Park, Calif.). Jan-Mar 1969.

In AEC unclassified programs.

Studies are being made on fundamental processes in radiolysis of organic systems. Energy transfer in pulse radiolysis of anthracene in benzophenone, the electronic structure of nonalternate compounds, photolysis of cyclooctane, and reactions of hydroxyl radicals are discussed. (M.C.G.)

105 (AI-AEC-12860, pp 37-42) RADIATION CHEMISTRY. (Atomics International, Canoga Park, Calif.). 1969.

In AEC unclassified programs.

The mechanism of triplet–triplet transfer in the nanosecond pulse radiolysis of solutions of 1,2-benzanthracene in naphthalene was studied. It is concluded that the solute triplet states are formed via collisions of solute molecules with excited triplet state solvent molecules. The pulse radiolysis of solutions of anthracene in benzophenone was studied to verify the identification of the benzophenone triplet and to study energy transfer from the solvent to anthracene. ESR spectroscopy and molecular orbital calculations were used to study the structure of purine and pyrimidine anions. ESR and sampling studies indicate that the

major radical yield from the uv photolysis of cyclohexane vapor at a pressure of 25 Torr is allyl; ethyl and cyclohexyl radicals are also formed. (J.G.B.)

106 (JAERI-Memo-4487) RADIOLYSIS OF THE MIXTURE OF UNSATURATED HYDROCARBON AND AMMONIA. I. FORMATION OF ETHYLAMINE FROM THE MIXTURE OF ETHYLENE AND AMMONIA. Tokunaga, Okihiro; Hamanoue, Kumao; Okamoto, Jiro; Danno, Akibumi; Sato, Shoichi (Japan Atomic Energy Research Inst., Tokyo). Jun 1971. 13p. (In Japanese and English). Dep. NTIS (U. S. Sales Only).

The γ radiolysis of a gaseous mixture of ethylene and ammonia was investigated, and the products of the decomposition were primarily hydrogen, ethane, butane, ethylamine, and acetylene. Yields of ethane, butane, and ethylamine increased with increasing concentration of ammonia, and the G-values of these products at 98 mole % ammonia were 0.52, 2.12, and 0.89, respectively. Addition of oxygen or nitric oxide as radical scavengers tended to reduce the yields of these products remarkably. The G-value of the ethyl radical was calculated from the values of ethane, butane, and ethylamine, and the limiting value of $G_{C_2H_5}$, determined by extrapolation to 100 mole % ammonia. The value thus obtained agrees with the initial G-value of the hydrogen radical, i.e., $G_H = 7.0 \pm 0.6$, which was obtained by Smithies, et al., in a study of the γ radiolysis of ammonia gas. From these results, it was concluded that thermal hydrogen radicals produced by γ radiolysis react quickly with ethylene, and resulting ethyl radicals lead to ethane, butane, and ethylamine. (auth)

107 (NP-19002) FREE RADICAL FORMATION IN HYDROCARBON CRYSTALS BY γ-IRRADIATION. ELECTRON SPIN RESONANCE SPECTRA OF SOME ALKYL RADICALS. Gillbro, Tomas; Kinell, Per-Olof; Lund, Anders (Forsknings-radens Laboratorium, Studsvik (Sweden)). Feb 1969. 38p. Dep. NTIS (U. S. Sales Only).

Single crystals and polycrystalline samples of the n-alkanes, pentane, hexane, heptane, nonane, decane and undecane, were prepared by a freezing technique. The crystals were irradiated at 77°K with ^{60}Co γ rays to a dose of 3 Mrad. Electron spin resonance in the X-band and Q-band demonstrated that $CH_3-CH-CH_2-R$ is the predominant radical species in all hydrocarbons except for undecane. The measured coupling constants found are the isotropic $a_1 = 25 \pm 1$ G (quartet), $a_2 = 33 \pm 1$ G (triplet) and the orientation dependent doublet splitting $a_3 = 12.5 - 33$ G. A complexity in the central region of the spectrum from undecane is thought to indicate the presence of additional alkyl radicals. Cleavage of the carbon chain is improbable. An irreversible decrease in line width with temperature is explained in terms of a disappearance of the dipolar interaction between radicals some 20 Å apart. In single crystals, indications of radical pair formation were found. The exclusive existence of the 2-alkyl radicals only suggests that the solid state favors a conformation in which the inductive effect of the methyl endgroup on the C(2)-H bond is strengthened. (auth) (Sweden)

108 RADIATION CHEMISTRY OF SATURATED-UNSATURATED HYDROCARBON SYSTEMS. III. KINETIC STUDY OF HYDROGEN FORMATION. Wojnarovits, L.; Fejes, P. (Isotope Inst., Budapest). Acta Chim. Acad. Sci. Hung.; 69: No. 2, 177-201(1971).

The reactions leading to radiation-chemical hydrogen evolution were studied in saturated–unsaturated and in open-chain–branched-chain hydrocarbon mixtures. These investigations showed that the great number of possible reaction steps can be divided into groups by drawing together kinetically indistinguishable processes of identical character and can be arranged in a reaction scheme suitable for kinetic investigations. This scheme includes reactions of the following types: initial absorption of energy, decomposition of saturated and unsaturated molecules leading to the formation of hydrogen atoms, arbitrary energy transfer from the saturated to the unsaturated molecule, possible energy loss by unsaturated molecules without decomposition leading to the formation of hydrogen atoms, "bimolecular" hydrogen evolution from hydrogen atoms by the intervention of saturated and unsaturated molecules, and hydrogen atom capture by unsaturated molecules. With the aid of optimization programs, a few of the characteristic relative rate constants of the above reactions have been determined using a digital computer. These relative rate constants permit deeper understanding of the so-called protective effect. One of the relative rate constants can be used for the numerical characterization of the various bond types. (auth)

109 Fe^{2+} AND RETENTION IN $K_3[Fe(C_2O_4)_3].3H_2O$ CRYSTALS IRRADIATED BY NEUTRONS AT LOW TEMPERATURE. Calusaru, A.; Rusi, A. (Inst. of Atomic Physics, Bucharest). Radiochim. Acta; 16: No. 1, 50-1(Aug 1971).

The experimental results obtained with crystals irradiated at very low temperature were not comparable with those obtained for crystals irradiated at room temperature. The oxidation of ^{24}Fe to ^{34}Fe was not only temperature dependent, but time dependent too. Even with a lead protection of 2.5- to 3-cm in. thickness, for a long irradiation period, an important radiolysis process may occur. (M.C.G.)

110 ROLE OF CRYSTAL DEFECTS IN THE ANNEALING OF CHLORITE IN GAMMA-IRRADIATED POTASSIUM CHLORATE. Mohanty, S. R.; Pandey, V. M. (Utkal Univ., Bhubaneswar, India). Radiochim. Acta; 16: No. 1, 53-4(Aug 1971).

It was found that, although direct recovery is induced by compression in γ-irradiated potassium chlorate, the rate of subsequent thermal annealing after a short period of heating is lower than that for the untreated crystals. (M.C.G.)

111 ESR STUDY OF ELECTRON CAPTURE BY GUEST MOLECULES IN IRRADIATED SINGLE CRYSTALS OF IMPURITY-DOPED ORGANIC COMPOUNDS: FUMARIC ACID-DOPED SUCCINIC ACID. Iwasaki, Machio; Muto, Hachizo; Toriyama, Kazumi (Government Industrial Research Inst., Nagoya, Japan). J. Chem. Phys.; 55: No. 4, 1894-9(15 Aug 1971).

The highly selective capture of an ejected electron by a small amount of guest molecules was found by the ESR study of a single crystal of fumaric acid-doped succinic acid irradiated at 77°K. The four-line spectrum due to the molecular anion found in an irradiated single crystal of pure succinic acid was replaced by the three-line spectrum when about 0.005 mole fraction of fumaric acid was doped in a single crystal of succinic acid. Analyses of the hyperfine and g tensors of this spectrum lead to the conclusion that the radical responsible for this spectrum is the molecular anion of fumaric acid, which is believed to be a precursor of the stable radical formed by the addition of the acidic proton to fumaric acid in the room temperature irradiation. Results suggest that the hydrogen addition radical is formed by the acidic proton transfer from the host molecule to the fumaric anion. The mechanisms for the formation of the stable radical and for the stereospecific addition of the acidic proton to the C=C bond are proposed based on the orientation of the guest molecule in the host crystal, which was determined by comparing the principal directions of the hyperfine and g tensors with the x-ray crystallographic data. (auth)

112 GAMMA RADIOLYSIS OF AQUEOUS STANNOUS BROMIDE SOLUTIONS. Stepenuck, Stephen Joseph Jr. Durham, N. H.; Univ. of New Hampshire (1971). 74p. University Microfilms Order No. 71-19,431.

Thesis.

Cobalt-60 γ radiolyses were carried out on dilute aqueous solutions of $SnBr_2$. Bromide, then HBr, concentration was varied in the general range of 1 to 3M. G(–Sn(II)) and $G(H_2)$ were determined after irradiations of 0.25 to 72 hr, at dose rates from 2.45 to 3.33×10^{18} e.v. g^{-1} min^{-1}. $G(H_2)$ descended from 2.0 for a 0.25-hr irradiation to a limiting value of 0.50 for irradiations 4 to 5 hr or longer. G(–Sn(II)) descended slowly from 2.50 at 4 hr irradiation to 0.49 for very long irradiations. G(–Sn(II)) was also determined for 10^{-2} M $SnCl_2$ in 1M HCl, and varied essentially the same as that for $SnBr_2$. G(–Sn(II)) for 10^{-3} M $SnSO_4$ in 0.8N H_2SO_4 was determined to be 0.51. High initial yields for the $SnBr_2$ system are postulated to be the result of oxidation of Br^- by H, with reductive reactions of H predominating on longer irradiation. It is believed that G(–Sn(II)) really behaves identically to $G(H_2)$, i.e., that slow descent of G(–Sn(II)) to 0.49 was due to lingering effects of a small amount of adventitious air-oxidation of irradiated solutions. Calculated curves based on this hypothesis match the experimental curves well. G(–Sn(II)) and $G(H_2)$ increased slightly with increasing Br^- of HBr concentration. (Diss. Abstr. Int., B)

113 ESR STUDY OF THE EFFECTS OF ALKALI METAL SUBSTITUTION ON THE RADICAL SPECIES PRODUCED AND THE STEREOSPECIFIC FORMATION OF RADICALS IN IRRADIATED CARBOXYLIC ACIDS. Toriyama, Kazumi; Muto, Hachizo; Iwasaki, Machio (Government Industrial Research Inst., Nagoya, Japan). J. Chem. Phys.; 55: No. 4, 1885-9 (15 Aug 1971).

A remarkable difference was found in the radical species produced when the alkali metal was changed from potassium to sodium in irradiated single crystals of acid salts of maleic acids. The room temperature stable species in an irradiated single crystal of potassium hydrogen maleate was previously found to be the symmetrical delocalized π radical formed by removal of the acidic proton. In contrast to this result, the stable species found in sodium hydrogen maleate was the radical formed by the addition of hydrogen to the double bond. Furthermore, it was found that the addition takes place selectively to one of the two vinylene carbon atoms, as is unexpected from the symmetrical structure of

the hydrogen maleate ion. A similar difference was also observed in the unstable species at 77°K. The potassium crystal gave the symmetrical σ radical formed by removal of the acidic proton while the sodium crystal gave the unsymmetrical σ radical. Here again the unpaired electron is selectively located in one of the two COO groups. These results indicate that the formation of radicals in crystalline solids is strongly affected by the surrounding crystalline field, since the sodium crystal is known to have a different crystal structure with hydrated water. (auth)

114 ESR STUDY OF OH RADICALS ORIGINATING FROM WATER OF CRYSTALLIZATION OF CARBOXYLIC ACIDS. I. SODIUM HYDROGEN MALEATE TRIHYDRATE. Toriyama, Kazumi; Iwasaki, Machio (Government Industrial Research Inst., Nagoya, Japan). J. Chem. Phys.; 55: No. 4, 1890-4(15 Aug 1971).

The OH radicals originating from water of crystallization were found in an irradiated single crystal of sodium hydrogen maleate trihydrate. This may be the first example of OH radical formation in hydrated organic crystals. Two types of OH radicals having different orientations and g tensors with nearly the same hyperfine tensors were found. The principal values of the g tensors were determined to be (2.0034, 2.0081, 2.0618) for OH(I), and (1.9947, 2.0065, 2.1198) for OH(II). The hyperfine tensors were found to be (–27.0, –44.7, +3.5)G and (–29.4, –44.8, +4.8)G, respectively, the relative sign being determined by the forbidden transitions. It was also found from the principal directions of the hyperfine and g tensors that the OH radicals are trapped in such a way that the O – H bonds in OH(I) and OH(II) are approximately parallel and perpendicular to the molecular plane of the hydrogen maleate ion, respectively, making an angle of 100° – 105° with each other. The larger g anisotropy in OH(II) is considered to come from such a difference in the trapping site that the radicals interact with the surrounding molecules more weakly. The energy separations of the two oxygen p_π orbitals were estimated to be 0.58 and 0.29 eV for OH(I) and OH(II), respectively. (auth)

115 ION–ELECTRON AND ION–ION RECOMBINATION COEFFICIENTS IN GASES STUDIED BY PULSE RADIOLYSIS. Sauer, Myran C. Jr.; Mulac, William A. (Argonne National Lab., Ill.). J. Chem. Phys.; 55: No. 4, 1982-3(15 Aug 1971).

An application of the technique of pulse radiolysis in which a time-resolved measurement of emitted light intensity is used to derive ion–electron and ion–ion recombination coefficients is described. Nitrogen was irradiated with 20-nsec pulses of 15-MeV electrons. Oxygen and argon–anthracene systems were also irradiated and excitation studied. (M.C.G.)

116 RADIOLYSIS OF ETHYL IODIDE–CHLOROMETHANE MIXTURES. Leblanc, R. M. (Davy Faraday Research Lab., London); West, M. A.; Woods, R. J.; Herman, J. A. Can. J. Chem.; 48: No. 8, 1273-9(15 Apr 1970).

Mixtures of ethyl iodide with chloroform, carbon tetrachloride, and dichloromethane were irradiated with ^{60}Co γ-radiation. Reduced yields of iodine, hydrogen iodide, and hydrogen chloride from ethyl iodide–chloroform and ethyl iodide–dichloromethane mixtures and of chlorinated ethanes from ethyl iodide–chloroform are attributed to radical scavenging by iodine and dissociative electron capture by the chlorinated methane. Electron capture by carbon tetrachloride followed by ion–molecule reactions between ethyl iodide cations and ethyl iodide, or neutralization of these cations by chlorine anions, explains iodine yields observed at low ethyl iodide concentrations in carbon tetrachloride greater than those expected on the basis of partition of absorbed energy. In this mixture, neutralization of an ethyl iodide cation by a chlorine anion gives rise to an enhanced hydrogen chloride yield. (auth) (Canada)

117 ABSORPTION SPECTRUM OF TRAPPED ELECTRONS IN 3-METHYLHEXANE GLASS AT 77°K. Klassen, N. V.; Gillis, H. A.; Walker, D. C. (National Research Council of Canada, Ottawa). J. Chem. Phys.; 55: No. 4, 1979-80(15 Aug 1971).

The absorption spectrum of trapped electrons in 3-methylhexane glass at 77°K immediately after an irradiation pulse of 35-MeV electrons was studied. The spectrum did not change significantly within 170 μsec after the pulse. (M.C.G.)

118 ENDOR STUDIES IN MOLECULAR CRYSTALS. I. GLUTARIC ACID AT 4.2°K. Kwiram, Alvin L. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys.; 55: No. 5, 2484-95(1 Sep 1971).

Two stable free radicals are formed in glutaric acid crystals on x irradiation. Ultraviolet illumination preferentially destroys one of these. Detailed ESR measurements are presented for the remaining radical and both radicals are studied by the ENDOR technique. Procedures for recovering the hyperfine tensor from the ENDOR data are presented. The contributions of the S_xI_x and S_yI_y terms are calculated to second order in the perturbation. The angular dependence of the anisotropic β-proton hyperfine interaction is calculated, and the results are compared with the observed behavior. (auth)

119 OXIDATION AND REDUCTION OF AMINO ACIDS BY IONIZING RADIATION. Box, Harold C.; Budzinski, Edwin E. (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys.; 55: No. 5, 2446-9(1 Sep 1971).

The effects of ionizing radiation on the amino acids β-alanine and ϵ-aminocaproic acid were studied in single crystals irradiated at 4.2°K. The paramagnetic species resulting from radioinduced oxidation and reduction processes were investigated using electron spin resonance and electron–nuclear double-resonance (ENDOR) spectroscopy. The reduced species is a free radical formed by the addition of an electron to the carbonyl oxygen of the carboxyl group. The ENDOR measurements indicate the oxidation product is a free radical derived from oxidized amino acid by the dissociation of CO_2. (auth)

120 ESR STUDY OF RADICAL STRUCTURE AND SYMMETRICAL HYDROGEN BOND IN A SINGLE CRYSTAL OF POTASSIUM HYDROGEN MALEATE IRRADIATED AT 77°K. Toriyama, Kazumi; Iwasaki, Machio (Government Industrial Research Inst., Nagoya, Japan). J. Chem. Phys.; 55: No. 5, 2181-90(1 Sep 1971).

ESR studies were carried out on the structure of radicals produced in an irradiated single crystal of potassium hydrogen maleate, which is known as a typical compound having a symmetrical intramolecular hydrogen bond. It was found that in the radical formed by removal of the acidic proton the unpaired electron occupies the σ antibonding orbital between the in-plane p orbitals of the two ring oxygen atoms, when the crystal is irradiated at 77°K. The principal values of the g tensor for this radical were determined to be $g_{xx} = 2.0043$, $g_{yy} = 2.0039$, and $g_{zz} = 2.0079$. The hyperfine couplings for the two vinylene protons are equivalent and have the nearly isotropic value of 5 ± 1 G. On the other hand, if the crystal is warmed up to room temperature after irradiation at 77°K, the same species of radical is formed but the unpaired electron occupies the delocalized π orbital. This radical is the same as that found in room-temperature irradiation which was previously reported. Both the radicals possess the mirror symmetry perpendicular to the C=C bond as does the mother molecule. The formations of such symmetrical radicals are closely related to the symmetrical structure and the extremely short O · · · O distance of the parent molecule, which are due to the symmetrical hydrogen bond. The cause of the formations of the σ and π electron radicals from the same mother molecule is also discussed. (auth)

121 SOLVATED ELECTRONS IN DIMETHYLSULFOXIDE. Walker, D. C.; Klassen, N. V.; Gillis, H. A. (National Research Council of Canada, Ottawa). Chem. Phys. Lett.; 10: No. 5, 636-8(1 Sep 1971).

The optical absorption spectrum obtained by pulse radiolysis of pure liquid dimethyl sulfoxide includes a broad intense band in the near ir with $\lambda_{max} \geq 1500$ nm. This band is assigned to solvated electrons with a half-life of 15 ± 2 nsec. The λ_{max} of the solvated electron correlates better with dimethyl sulfoxide's inability to solvate negative ions than with its dielectric constant, which is 48. (auth)

122 PRIMARY ACTIVE STATES IN THE DESTRUCTION OF ALPHA-METHYLSTYRENE BY LIGHT AND GAMMA RADIATION. Kardash, N. S.; Krongauz, V. A. (Physical-Chemical Inst., Moscow). Dokl. Akad. Nauk SSSR; 197: No. 4, 836-9 (1 Apr 1971). (In Russian).

Elucidation of the nature of primary active states (electron excitation or ionization) is important to an understanding of the mechanism of polymer destruction. The changes in the polymer length of α-methylstyrene when exposed to 253-μ light were followed by the viscosity of a toluene solution of the irradiated product. The number of bond ruptures was proportional to the radiation dose. The addition of an acceptor such as p-terphenyl (0.01 to 0.1 M) lowered the quantum yield in the photolysis of polymethylstyrene by a factor of 2.5. Similar results were obtained in the radiolysis of poly(methylstyrene) with and without protective additives. This behavior is discussed in terms of energy transfer from activated states. (K.S.W.)

123 IDENTIFICATION AND QUANTITATIVE DETERMINATION OF SOME RADIOLYSIS PRODUCTS OF NICOTINIC ACID AFTER γ IRRADIATION. Washuettl, J. (Technische Hochschule, Vienna). Mikrochim. Acta; No. 3, 547-53(1971). (In German).

Following γ-irradiation with 500 krad in aqueous solutions of

0.5 g nicotinic acid/l, the following radiolysis products along with nicotinic acid were detected and determined: hydrogen peroxide, acetone, 3-hydroxypyridine, 6-hydroxynicotinic acid, and ammonium ions. Possible origins of these products are discussed. (auth)

124 ELECTRONIC PROCESSES IN THE PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF HALIDE IONS. Khorana, Shamsher; Hamill, William H. (Univ. of Notre Dame, Ind.). J. Phys. Chem.; 75: No. 20, 3081-8(30 Sep 1971). (COO-38-770).

Formation of Cl_2^- in radiolytic systems at high $[Cl^-]$ and pH ~7 does not involve OH in the acid spur because $G(Cl_2^-)$ is not markedly decreased by concentrated bases. $G(Cl_2^-)$ in air-free solutions increased only from 2.80 to 3.06 as H^+ increased from 10^{-2} to 1 M. The results indicate $G_{OH} = 2.80$ is almost equal to $G^0(OH)$. The results are consistent with $Cl^-_{aq} + H_3O^+ \rightarrow Cl + H_2O$. High concentrations of F^- increase $G(e^-_{aq})$ and OH^- increases G(OH), both attributed to charge transfer to H_3O^+. At high $[I^-]$, $G(I_2^-)$ approaches a limiting value of 6.0 equiv, while $G(I_2^-)$ first increases to ~3, then decreases to ~1.8. The mechanism may involve $I^-_{aq} + H_3O^+ \rightarrow I + H + OH$, since somewhat more energy is available with I^-_{aq} than with Cl^-_{aq}. Measuring G(OH) as $G(I_2^-)$ in 10^{-2} to 10^{-1} M I^- at 0 to 2 M $C_2H_3O_2^-$, $-\Delta G(I_2^-)$ approaches a limiting value ~3 after correcting for competition of I^- and $C_2H_3O_2^-$ for OH. The effect is attributed to electron transfer from $C_2H_3O_2^-$ to H_3O^+. For 1 M Cd^{2+}, $G(Cd^+)$ decreased from 3.76 to 3.55 as $[H^+]$ increased from 0 to 1 M. The results indicate that $G^-_{aq} \cong G^0(e^-_{aq})$. (auth)

125 GAS-PHASE RADIOLYSIS OF NITROUS OXIDE. THE EFFECT OF THE ADDITION OF SEVERAL HYDROCARBONS. Takao, Satoshi; Hatano, Yoshihiko; Shida, Shoji (Tokyo Inst. of Tech.). J. Phys. Chem.; 75: No. 20, 3178-82 (30 Sep 1971).

The effect of the addition of several paraffins and olefins on the gas-phase radiolysis of N_2O was examined. The total G values of oxygen-containing products at 3% hydrocarbons added were around 6.8 irrespective of the nature of hydrocarbons, while $G(N_2)$ decreased by about 2.6. Consideration of possible reaction schemes both on ionic and nonionic processes leads to the conclusion that excited oxygen atoms play a major role in the nonionic processes in the gas-phase radiolysis of N_2O. On the basis of the ionic processes proposed previously and of the nonionic processes assumed here, the main features of the primary processes in the radiolysis of N_2O can be depicted as

$$N_2O \rightsquigarrow \begin{cases} N_2O^+ + e^- & G = 3.0 \\ N_2 + O^* \text{ (excited states)} & G \sim 4 \\ N_2 + O \text{ (the ground state)} & G < 0.5 \end{cases}$$

(auth)

126 EPR PULSE RADIOLYSIS STUDIES OF THE HYDROGEN ATOM IN AQUEOUS SOLUTION. I. REACTIVITY OF THE HYDROGEN ATOM. Smaller, B.; Avery, E. C.; Remko, J. R. (Argonne National Lab., Ill.). J. Chem. Phys.; 55: No. 5, 2414-18(1 Sep 1971).

The transient properties of hydrogen and deuterium atoms produced by pulse radiolysis in water were studied by EPR. Details of the EPR instrumentation are described. From decay characteristics of the EPR signal on addition of various solutes, rate constants for the reaction of atomic hydrogen with various classes of molecules were determined. Agreement of our results with prior indirect determinations is, in general, good. The isotope effect is also in agreement with expectation. (auth)

127 AROMATIC SOLUTE MOLECULAR ION AND TRIPLET STATE FORMATION IN POLYSTYRENE AND POLYMETHYLMETHACRYLATE. Siegel, Seymour; Stewart, Thomas (Aerospace Corp., El Segundo, Calif.). J. Chem. Phys.; 55: No. 4, 1775-87(15 Aug 1971).

Solutions of naphthalene-d_8 and N,N,N′,N′-tetramethyl-p-phenylenediamine (TMPD), singly and in combination, in polystyrene (PS) and polymethylmethacrylate (PMMA) were irradiated by 1.9-MeV electrons at 86°K. The irradiation pulse had a half-width of 0.7 sec. Examination of the absorption spectra of samples immediately after the irradiation pulse indicated that solute triplet state molecules and positive ion molecules were produced, with TMPD as the solute in both polymer hosts. With naphthalene, positive ions were observed only in PMMA, whereas triplet state molecules were observed in both polymers. Analysis of the data from the mixed solute samples indicated that the presence of 0.05M TMPD captures all of the mobile positive charge, even when the naphthalene concentration is as high as 0.2M. Surprisingly, the production of naphthalene triplet state molecules is only slightly affected by the presence of TMPD. Charge migration or delocalization over appreciable distances occurs in both polymers. The radiation yields of triplets and ions in the two polymers are discussed and compared. PMMA is just as effective as PS in producing triplet excited states of the aromatic solute in terms of limiting yields at high solute concentration, but the concentration dependence is different in the two polymers. From an analysis of the G values of the various transient species as functions of the solute concentration and temperatures and by comparisons with published work performed with nanosecond and microsecond electron pulses, deductions are made with regard to charge capture and migration in these systems. The implications of these deductions with regard to primary radiation mechanisms are discussed. (auth)

128 ESR STUDY OF $\cdot CF_2COO^-$ RADICALS IN IRRADIATED SINGLE CRYSTALS OF SODIUM CHLORODIFLUOROACETATE. Rogers, Max T.; Kispert, L. D. (Michigan State Univ., East Lansing). J. Chem. Phys.; 55: No. 5, 2360-9(1 Sep 1971).

Electron spin resonance studies were made of the radicals produced by electron irradiation of sodium chlorodifluoroacetate at room temperature. Three sets of $\cdot CF_2COO^-$ radicals were observed, each with a somewhat different conformation or local environment in the crystal lattice, but each with nearly the same principal values of the hyperfine splitting tensor for the two equivalent α-fluorine atoms. One radical occupies two sets of nonequivalent positions characteristic of the space group. A second radical also shows site splitting in the ESR spectrum, but the maximum separation is only about 14 G since the maximum principal component of the hyperfine splitting tensor lies nearly parallel to the a axis of the monoclinic unit cell and one of the smaller principal values is nearly parallel to b. A third radical has its maximum principal hyperfine splitting direction perpendicular to b and minimum value parallel to b so that no site splitting is observed; however, triplet superhyperfine structure from interaction with two equivalent nuclei of spin one-half is present. The hyperfine coupling tensors were evaluated and the structures of the radicals discussed. The radicals undergo some reorientation in the lattice on cooling from 300 to 77°K. Incomplete data for $\cdot^{13}CF_2COO^-$ indicate that these radicals are probably nonplanar with the unpaired electron in an orbital with some s character. Exposure to air or gaseous oxygen converts all these to peroxide radicals, each of which gives only a single ESR line. (auth)

129 EFFECT OF PRESSURE ON THE RATES OF REACTION OF RADIOLYSIS INTERMEDIATES IN LIQUID n-HEXANE. Jha, K. N.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Chem.; 49: 2651-6(15 Aug 1971).

The yield of hydrogen from pure hexane, $G(H_2) = 5.3 \pm 0.2$, was independent of pressure in the range 1 bar to 4.6 kbars. The G values of H_2, HD, and D_2 obtained from 11 mol % C_6D_{14} in C_6H_{14} were independent of pressure and were respectively, 4.85, 0.34, and 0.11. The electron and hydrogen atom scavenging efficiencies of carbon tetrachloride and hexadiene-1,3, and the hydrogen atom scavenging efficiency of hexene-1 were independent of pressure. The positive ion scavenging efficiencies of benzene and aniline increased with increasing pressure. The volume of activation for the hydrogen atom reaction with n-hexane is essentially the same as that for the reaction with hexene-1. The pressure dependence of the charge scavenging reactions was interpreted in terms of the kinetics of spur processes. The treatment is consistent with the fact that the efficiency of the electron scavenging reactions is independent of pressure. The increased efficiency of positive ion reaction under pressure implies that the ratio of the diffusion coefficients of the radiolytic positive ion and electron, D_+/D_-, increases with increasing pressure. (auth) (Canada)

130 ELECTRONIC SPECTRA OF ION-RADICALS AND THEIR MOLECULAR ORBITAL INTERPRETATION. I. AROMATIC NITRO-SUBSTITUTED ANION-RADICALS. Shida, Tadamasa; Iwata, Suehiro (Inst. of Physical and Chemical Research, Wako, Japan). J. Phys. Chem.; 75: No. 17, 2591-2602(19 Aug 1971).

A number of hitherto unknown electronic spectra were observed for aromatic nitro-substituted anion radicals produced in γ-irradiated rigid solutions at 77°K and are compared with an SCF–MO calculation. The strong character of the nitro group has a decisive influence on the whole electronic states of the ions and the transitions can often be characterized clearly with simple excitation modes such as charge resonance and charge transfer between nitro groups and between nitro and hydrocarbon constituents. Systematic effects of alkylation and of twisting the nitro group are found for many cases and are accounted for consistently by the theory. (auth)

131 INVESTIGATION OF RADICALS FORMED DURING γ-IRRADIATION OF ALKYL HALIDES IN THEIR OWN MATRIX AND IN UREA AT 77°K. Kuleshov, A. P.; Trofimov, V. I.; Chkheidze, I. I. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 4: No. 6, 483-8(Nov-Dec 1970).

Translated from Khim. Vys. Energ.; 4: No. 6, 535-40(Nov-Dec 1970).

The formation of radicals during γ radiation of five halogenoparaffins in the pure form and in a urea matrix at 77°K was investigated by the EPR method. It was shown that in alkyl halides containing at least five CH_2 groups in the chain, radicals are formed by the splitting off of the halogen atom. In n-propyl bromide and isopropyl iodide, this process does not play the main role. Straight-chain alkyl halides containing at least five CH_2 groups form stable clathrates with urea at room temperature. Branched alkyl halides do not enter into the voids in the urea matrix. Radicals formed from alkyl halides are more stable in the urea matrix than in their own matrix. In urea, these radicals have a different geometry and do not undergo oxidation even at room temperature. (auth)

Radioisotope Production

Refer also to abstract 172.

132 (CEA-R-3153(Pt.3)) DRY METHOD FOR PREPARATION OF ^{131}I STARTING WITH IN-PILE IRRADIATED ELEMENTARY TELLURIUM. PART III. PRODUCTION ON A SEMI-INDUSTRIAL SCALE. Murthy, Tantravahi S.; Bardy, Andre; Doyen, Jean-Bernard; Lefrancois, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 12 Dec 1967. 12p (In French). Dep. NTIS (U. S. Sales Only).

A stainless steel apparatus and an operational method adapted to the processing of large amounts of tellurium and to the production of high iodine-131 activities were developed. The method is an adaptation of that described in two preceding reports; it involves heating the irradiated tellurium at 400°C in an argon stream; the temperature is then increased to 720°C to desorb the iodine-131 which is partially fixed to the steel. Several runs were carried out using iodine-131 activities of from 15 to 40 curies; the yield was about 75%. (auth)

133 (FOA-4-4463) TRANSURANIUM ELEMENTS: PRESENT AND FUTURE. Wallin, Lars Bertil (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Jun 1971. 70p. (In Swedish). Dep. NTIS (U. S. Sales Only).

A survey of the transuranium elements is presented. A large number of examples of current and potential applications are given. Production methods, present and future production programs, and demands and prices for the most important elements are discussed. The search for superheavy elements and the attempts to produce them are touched upon. (auth) (Sweden)

134 (JINR-D7-6013) CHEMICAL ELEMENTS OF THE SECOND HUNDRED. Flerov, G. N.; Zvara, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. 88p. (In Russian). Dep. NTIS (U. S. Sales Only).

Work conducted at Dubna on the study of nuclear and chemical properties of transfermium elements since the Third International Conference on the Peaceful Uses of Atomic Energy is reviewed. Methods for synthesis, detection, and identification of the new elements are considered. The history of the discovery of the elements with numbers 102 to 105 at Dubna is outlined. The current status of search for superheavy elements in nature is discussed as well as the prospects for their production in nuclear reactions induced by heavy ions. (auth)

135 SOME FACTORS INFLUENCING THE ELUTION OF ^{99m}Tc GENERATORS. Cifka, J.; Vessely, P. (Nuclear Research Inst., Rez, Czech. State Inst. for Control of Drugs, Prague). Radiochim. Acta; 16: No. 1, 30-5(Aug 1971).

Reasons for occasionally low yields of ^{99m}Tc eluted from technetium-99m generators were studied. Drying out or absence of chloride ions before the first elution cannot be blamed for this fact. Ionizing radiation causes the increase of the retention of ^{99m}Tc on the column, probably due to reduction to the Tc(IV)-form, which is strongly adsorbed on alumina. It was proved by a number of experiments that radiation reduction of pertechnetate occurs only after the exhausting of oxygen present in the system. Outgassing does not change the valency state of ^{99m}Tc orginating by beta desintegration of molybdenum-99. (auth)

136 SELF CONTAINED, CLOSED SYSTEM, AND METHOD FOR GENERATING AND COLLECTING A SHORT LIVED DAUGHTER RADIONUCLIDE FROM A LONG LIVED PARENT RADIONUCLIDE. Deutsch, Marshall E.; Mead, Louis W.; Nagy, Zoltan (to Nen-Picker Radiopharmaceuticals, Inc.). U. S. Patent 3,576,998. 4 May 1971. Filed 16 Nov 1966.

A sterile, pyrogen free, self-contained closed radionuclide generator system in which the eluant for extracting the daughter from the generator column, containing the parent and daughter on a supporting substrate, is prepackaged and stored in a predetermined amount in a sealed, flexible, collapsible plastic bag is described. The bag is sealably connected to the generator column by a conduit. The eluant is drawn from the bag through the generator column and is automatically withdrawn from the column and collected as an eluate of the daughter in the eluant by impaling a pierceable wall of a sealed evacuated eluate-collecting tube on a cannula which is sealably connected to the generator to thereby apply a vacuum to the eluant in the bag to draw it through the generator and cannula into the evacuated eluate collecting tube. (Official Gazette)

Recoil Production and Reactions

Refer also to abstracts 144 and 147.

137 CHEMICAL EFFECTS OF THE $^{31}P(n,\gamma)^{32}P$ REACTION IN $K_4P_2O_7$. Fenger, J. (Danish Atomic Energy Commission, Risoe). Radiochim. Acta; 16: No. 1, 42-5(Aug 1971).

Anhydrous potassium pyrophosphate ($K_4P_2O_7$) was reactor-irradiated under different well-defined conditions with the special aim of studying the possible formation of ^{32}P-labeled anions with three or more phosphorus atoms. The total yield (~7%) of normal tri- and polyphosphates was much lower than expected and previously found with similar compounds. It is suggested that condensed phosphates are primarily formed with ^{32}P in a reduced state, and that these species are partly annealed before the analyses. A tempering experiment demonstrates that thermal annealing proceeds via a breaking-down of species that are not of the P–O–P form, giving a transitory increase in the yield of the species with on P atom only. Subsequently P^5–O–P^5 is formed by recombination and oxidation. (auth)

138 ABSENCE OF $^{35}S(^1D)$ REACTIONS WITH PROPANE FOR ENERGETIC ^{35}S ATOMS FROM NUCLEAR RECOIL. I. Church, Larry B.; Rowland, F. S. (Univ. of California, Irvine). Contract AT(11-1)-34. Radiochim. Acta; 16: No. 1, 55-7 (Aug 1971).

Experiments involving C_3H_8 as the substrate molecule for ^{35}S atom reactions were carried out in an effort to determine the spin states of ^{35}S involved in these processes. Energetic ^{35}S atoms were formed by thermal neutron irradiation of $COCl_2$. Very few ^{35}S atoms were found to undergo chemical reaction from the ^1D state. (M.C.G.)

139 USE OF SCAVENGERS IN STUDIES OF REACTIONS OF RECOIL ATOMS. Malcolme-Lawes, D. J. (Yale Univ., New Haven). Contract AT(30-1)-1957. Radiochim. Acta; 16: No. 1, 57-9(Aug 1971).

A theoretical study was made of the effects of different reactivities of scavenger species in reactions of recoils. In moderation studies of hot atom reactions the use of a constant reactant/scavenger ratio may produce misleading results. Maintenance of a sufficient amount of scavenger to suppress thermal processes while not interfering with hot reaction yields is the "ideal" in moderation studies. (M.C.G.)

140 TEMPERATURE DEPENDENCE OF SIMPLE HOT ATOM REACTIONS. Chang, H. M.; Wolfgang, Richard (Yale Univ., New Haven). J. Phys. Chem.; 75: No. 20, 3042-6(30 Sep 1971).

The magnitude of temperature effects of hot atom reactions is evaluated. Simple theoretical calculations indicate that the effect of thermal translational motion on the apparent threshold is greatest for light substrate molecules and high true threshold processes. It is also apparent that hot reaction yields are very weakly dependent on such temperature effects, and that the latter would normally escape detection by the usual techniques. Temperature effects due to internal motion of substrate molecules are more difficult to estimate and may often be somewhat larger than those due to translation. Experimental studies fail to confirm a previous report of a large temperature effect on the yield of HT from reactions of recoil tritium with n-butane. (auth)

Radiochemistry

Refer also to abstract 133.

141 (BNWL-SA-2786) NUCLEAR POWER CONTRIBUTIONS TO THE RESOURCES OF PLATINUM GROUP METALS. Rohrmann, Chas. A. (Battelle-Northwest, Richland, Wash. [Pacific Northwest Lab.]). 9 Sep 1969. Contract AT(45-1)-1830. 25p. (CONF-690909-4). Dep. NTIS.

From one hundred and fifty-eighth National Chemical Society; New York (7 Sep 1969).

Ruthenium, rhodium, and palladium are among those elements produced in highest yield via fission. In power reactors it is also conceivable that significant quantities of osmium could be produced by irradiation of tungsten. There is no conceivable practical

manner by which platinum or iridium could be produced via nuclear reactions. Of these four producible platinum group metals, only ruthenium would be so intensely radioactive that its use would have to be limited to those applications that could take distinct advantage of this radioactivity. Assuming effective chemical separation from neighboring elements, radioactivity of the recovered platinum metals is expected to be moderate to insignificant. The only significant active palladium isotope is ^{107}Pd, which is a pure beta emitter of very low energy and very long half-life. The presence of traces of intensively active, gamma-emitting ^{102m}Rh requires a more cautious expectation for the economic exploitation of fission product rhodium. The activity of this palladium and rhodium is not expected to exceed 100 microcuries per gram. In about ten years fission product rhodium recoverable annually from civilian nuclear power will exceed that utilized in the U. S. from conventional sources. A similar situation will exist for palladium in about thirty years. Fission product rhodium has been alloyed with platinum and successfully tested at the pilot plant stage for ammonia oxidation. (auth)

142 CALIBRATION OF ^{197}Hg, MEASUREMENT OF COEFFICIENT OF INTERNAL CONVERSION AND OF THE P_k CAPTURE RATIO. Plch, J.; Zderadicka, J.; Bucina, I. Radioisotopy; 12: No. 1, 131-67(1971). (In Czech).

The coincidence of electrons and K photons was used for measurement of ^{197}Hg. The electrons are detected in a 2π proportional detector, the K photons in a Si(Li) scintillation detector. The accuracy of the determination of activity was ±1.2% in the case of the Si(Li) detector and ±2.1% in the case of the scintillation detector. Coincidence measurement of K photon spectra with the use of the Si(Li) detector showed that $(1 \pm \alpha_{77}) \cdot P_k \cdot \omega_k = 4.008 \pm 0.08$, by measurement in 4π scintillation counter then $P_k \cdot \omega_k = 0.741 \pm 0.012$ and the conversion factor 77 keV $\alpha_{77} = 4.42 \pm 0.1$. On the basis of these data a relation was found between impulse activity and counting rate, recorded by the 4π scintillation counter enabling a simple calibration with an accuracy of ±2%. (auth)

143 A $4\pi\beta-\gamma$ COINCIDENCE METHOD FOR MIXED ELECTRON-CAPTURE/POSITRON EMITTERS: THE ABSOLUTE MEASUREMENT OF ^{68}Ga. Smith, D.; Williams, A. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop.; 22: No. 10, 615-23(Oct 1971).

An extension of the $4\pi\beta-\gamma$ coincidence technique to measure the absolute disintegration rate of mixed electron-capture/positron emitters is described. The method involves determining both the positron detection efficiency, ϵ_0, and the detection efficiency, ϵ_r, for a branch containing a significant amount of electron capture. The absolute disintegration rate is obtained by extrapolating the observed β count rate to $\epsilon_0 = 1$ and $\epsilon_r = 1$ simultaneously. This technique was used to measure the disintegration rate of ^{68}Ga, giving a calibration figure of 28.78 pA/mCi for the type 1383 A ionization chamber used without liner, with a standard error of 0.13 pA/mCi and a systematic error of 0.25 pA/mCi. The half-life of the isotope was determined as 67 min 48 sec with a standard error of 1 sec and a systematic error of 4 sec. (auth)

144 INVESTIGATION OF RADIATION DAMAGE IN Re COMPOUNDS BY ANGULAR CORRELATIONS. Badica, T. (Inst. for Atomic Physics, Bucharest); Gelberg, A.; Salageanu, S.; (and others). Radiochim. Acta; 16: No. 1, 36-9(Aug 1971).

Gamma–gamma angular correlations in the decay of ^{188}Re were investigated. The sources were prepared by neutron irradiation of NH_4ReO_4, $NaReO_4$, and K_2ReCl_6; measurements were also carried out with annealed sources. Strong perturbations of both magnetic and electric origin were observed. The influence of irradiation time and annealing is discussed. (auth)

145 INFLUENCE OF MOLECULAR GEOMETRY, ORIENTATION, AND DYNAMICS ON ANGULAR CORRELATION PATTERNS FROM ROTATIONALLY LABELED MACROMOLECULES. Shirley, D. A. (Univ. of California, Berkeley). J. Chem. Phys.; 55: No. 4, 1512-21(15 Aug 1971).

In order to determine the sensitivity of gamma angular correlation patterns from solute macromolecules labeled with rotational tracers such as ^{111m}Cd, a theoretical study was made of the behavior expected under certain conditions. A nucleus of spin $^5/_2$, acted upon by an axially symmetric electric field gradient, and bound to a rodlike macromolecule, was considered. Under static conditions (no molecular rotation), the time-dependent correlation pattern is quite sensitive to molecular orientation and, for oriented molecules, to the angle between the axis of the field-gradient tensor and the molecular axis. A general equation and results for selected geometric configurations are given. When molecular rotation is allowed, a classical model is applicable if the rotation is sufficiently slow. This model is used to calculate relaxation curves for several geometrical configurations under the condition that the macromolecules rotate about their long axes. These curves are shown to have considerable diagnostic value. Finally, the applicability of rotational tracers in the light of these results is discussed. (auth)

146 CHEMICAL EFFECTS OF THE β-DECAY OF ^{125}Sb IN AMMONIUM HALO-ANTIMONATES(III) AND -ANTIMONATES(V). Ambe, Shizuko; Saito, Nobufusa (Inst. of Physical and Chemical Research, Yamato, Japan). Radiochim. Acta; 16: No. 1, 40-1 (Aug 1971).

The oxidation states of ^{125m}Te atoms as β-decay products of ^{125}Sb were studied in ammonium haloantimonates(III) and -antimonates(V). In all the haloantimonates(III), more than 99% of the ^{125m}Te atoms was found in the tellurium(IV) fraction. In the case of the haloantimonates(V), the distribution of the chemical states of the ^{125m}Te was found to depend on the electronegativity of the ligand halogen. (auth)

147 ESCAPE OF THORON FROM THORIUM DIOXIDE. Saito, Yasutoshi (Akita Univ., Japan). Funtai Oyobi Funmatsuyakin; 17: No. 7, 300-6(Apr 1971). (In Japanese).

Hahn's emanation technique using the escaping tendency of 54.5-sec thoron was applied to the following studies: (1) the effect of calcination temperature on the specific surface area of thorium dioxide prepared from the oxalate and (2) activation energies for the diffusion of thoron in thorium dioxides prepared from oxalate, hydrous oxide, and oxycarbonate by firing at 1050°C. The measured emanation activity was simply assumed to be composed of the recoil fraction and diffusion fraction. The room-temperature emanation activity, which can be taken as being equal to the recoil fraction and being proportional to the specific surface area, decreased with increasing calcination temperature, and it corresponded well to the decrease in the measured specific surface area and the rate of absorbing water vapor. From the Arrhenius plots of the diffusion fraction, which was obtained by subtraction of the room-temperature emanation activity from the measured activity at each temperature, activation energies for the diffusion of thoron in thorium dioxide were determined. Depending on the temperature and the source of the oxide, different activation energy processes could be attributed to the various diffusion processes. (auth) (Japan)

Separation Processes

Refer also to abstracts 25, 45, 47, 48, 146, 298, 360, and 1575.

148 (BARC/I–88) NATURE AND TREATMENT OF RADIOACTIVE LIQUID WASTES ARISING DURING THE PROCESSING OF URANIUM CONCENTRATES. Kharbanda, J. L.; Deshmukh, Usha; Khan, A. A. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 10p. INIS.

Significant quantities of radioactive wastes are produced during the processing of uranium ore concentrates. Studies were carried out with the effluent samples obtained from the Uranium Metal Plant, Trombay, to formulate suitable procedures for the treatment and disposal of different radioactive waste streams that are likely to be produced at the Nuclear Fuel Complex, Hyderabad. Detailed chemical and radiochemical analyses were done and the suitability and effectiveness of different chemical precipitation processes for decontamination were studied. Effluent samples were analyzed for their gross activities, ^{234}Th and ^{226}R. It is shown from the estimated quantities of the active effluents produced and their radiochemical analysis that more than 80% of the total beta-gamma activity is due to the presence of ^{234}Th. A satisfactory procedure for the treatment of this radioactivity has been formulated. (INIS)

149 (DOCKET-50201–90) WEST VALLEY REPROCESSING PLANT. Safety Evaluation for Transfer and Processing of Plutonium Nitrate–Uranyl Nitrate Solutions, Addendum 2. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 29 Oct 1971. 15p. Dep. NTIS.

Information is presented in response to questions on the application to process Category 10 fuels (plutonium nitrate–uranyl nitrate solutions). Fuel content of the solutions, bottle identification, transfer to dissolver, critical concentration in dissolver, dissolver boil-down, feed adjustment, loadin box sump transfers, dissolver charging, and rework solution concentration are discussed. (M.C.G.)

150 (DOCKET-50201–91) WEST VALLEY REPROCESSING PLANT. Technical Specifications, Proposed Change in Process. (Nuclear Fuel Services, Inc., Rockville, Md.). 5 Nov 1971. 37p. Dep. NTIS.

A proposal is presented to delete the ion exchange plutonium purification step and substitute a second extraction cycle similar to the present first cycle extraction step. Suggested modifications to the technical specifications are included. The existing facility, equipment deletions, second solvent extraction cycle, nuclear safety evaluation, seismic evaluation, effects of a tornado, quality assurance, and technical specifications are discussed. (M.C.G.)

151 (DOCKET-50268-16) MIDWEST FUEL RECOVERY PLANT. Statement Why License Should Not Be Suspended Pending Completion of NEPA Environmental Review. (General Electric Co., San Jose, Calif.). 25 Oct 1971. 10p. Dep. NTIS.

Information is presented in support of a request for materials license for receipt and installation of radioactive sources and solutions, receipt and use of unirradiated natural uranium, and receipt and storage of irradiated fuel assemblies. The environment impact of these activities is discussed. (M.C.G.)

152 (DOCKET-50268-17) MIDWEST FUEL RECOVERY PLANT. Amendment No. 3, Supplement No. 1, Design and Analysis. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). Oct 1971. 44p. Dep. NTIS.

Information is presented on: analysis of effects of tornado-generated missiles on the storage basins and effects of a 3 psi pressure drop in 3 sec on the processing building. (M.C.G.)

153 (DOCKET-50268-18) MIDWEST FUEL RECOVERY PLANT. Amendment No. 15, Supplement No. 1, Demonstration of Compliance to Criteria. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). Oct 1971. 83p. (NEDO-10178-8). Dep. NTIS.

Criteria and compliance information are presented for plant facilities and shutdown, plant feed, radiological protection and confinement, nuclear safety, chemical safety, and mechanical and structural safety. (M.C.G.)

154 (DOCKET-50268-19) MIDWEST FUEL RECOVERY PLANT. Amendment No. 19, Response to AEC Staff Questions of July 30, 1971 and August 6, 1971. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 19 Oct 1971. 28p. (NEDO-10178-7). Dep. NTIS.

Information is presented in support of the final safety analysis report. Questions are answered on thermal gradients across canyon wall, waste vault liner anchorage and corrosion, cell liner integrity, fuel basin liner impact protection, cask basin construction details, fuel basket details, cask drop, main process stack, process boiler stack, reinforced concrete details, and seismic design. (M.C.G.)

155 (DOCKET-50268-20) MIDWEST FUEL RECOVERY PLANT. Response to AEC Staff Questions Regarding Environmental Report. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 19 Oct 1971. 14p. (NEDO-14504-1). Dep. NTIS.

Additional information is presented in regard to the environmental report. Topics covered include: pre- and post-operational environmental monitoring program, chemical form of radioactive stack effluents, releases, future use of site, weather conditions, and radioactivity release. (M.C.G.)

156 (DOCKET-50268-21) MIDWEST FUEL RECOVERY PLANT. Environmental Report, Supplement No. 1. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 4 Nov 1971. 88p. (NEDO-14504-2) Dep. NTIS.

Information is presented on the environmental impact of the Midwest Fuel Recovery Plant, radioactive material transportation, and potential accidents. Additional information is included on cost-benefit analyses. (M.C.G.)

157 (DOCKET-50332-21) BARNWELL NUCLEAR FUEL PLANT. Effects of Possible Suspension of Construction on Cost and Schedule of Plant. (Allied-Gulf Nuclear Services, Barnwell, S. C.). 3 Nov 1971. 18p. Dep. NTIS.

The effects of possible suspension of construction of the Barnwell Nuclear Fuel Plant on the cost and schedule of the plant and the related effects on neighboring communities are discussed. The delay is projected to be the period of such suspension plus a minimum of 6 months. Estimated cost penalties total $13,304,000, and an estimated 2,025 jobs would be affected. (M.C.G.)

158 (DOCKET-50332-22) BARNWELL NUCLEAR FUEL PLANT. Environmental Report (Updated). (Allied-Gulf Nuclear Services, Barnwell, S. C.). 5 Nov 1971. 794p. Dep. NTIS.

The environmental impacts of the Barnwell plant are considered. The changes and progress that have taken place since the earlier Environmental Report are highlighted. The site, the plant, environmental effects of site preparation and plant construction, environmental effects of plant operation, environmental effects of accidents, alternatives to construction and operation of the plant, costs and benefits of plant and alternatives, and environmental approvals and consultation are discussed. (M.C.G.)

159 (IEA-219) PILOT PLANT FOR PURIFICATION OF URANIUM BY ION EXCHANGE IN IEA OPERATIONS. Abrao, Alcidio; Franca, Jose Monteiro Jr. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Aug 1970. 94p. (In Portuguese). Dep. NTIS (U. S. Sales Only).

The installation and operation of a pilot plant for uranium purification based on an ion-exchange process are described. The preparation of uranyl nitrate solution, used to feed the ion-exchanger columns, is performed by fractional dissolution of raw sodium diuranate. The decontamination of thorium plus rare earth elements is achieved by oxalic acid precipitation directly in the bulk of uranyl nitrate. The decontamination of various impurities is enhanced by an EDTA-complex formation before the uranyl load on the strong cationic resin bed. The uranyl sulfate obtained by eluting the resin column with ammonium sulfate is reverse precipitated to avoid sulfate coprecipitation in the nuclear grade ammonium diuranate obtained. (auth)

160 (INR-P-1308) ESTIMATE OF THE WORLD DEVELOPMENT OF THE AQUEOUS METHODS OF SPENT NUCLEAR FUEL REPROCESSING. Bednarchik, V. (Institute of Nuclear Research, Warsaw (Poland)). 1971. 34p. (In Russian). (CONF-710524-1). Dep. NTIS (U. S. Sales Only).

From second symposium on research in spent fuel reprocessing; Marianske Lazne, Czechoslovakia (10 May 1971).

The most important reasons for the industrial success of aqueous reprocessing methods are mentioned and their further development trends are indicated (the improvement of existing methods and elaborating new methods for highly irradiated fuels of the future). The field of research and development studies is also described. The present development status of aqueous methods is reviewed. Decladding and fuel dissolution are specially considered. In the part concerning decontamination, separation, and purification, problems connected with amines and ion exchange application are discussed. Some attention is given to uranium–thorium and plutonium fuels. The significance of aqueous methods as well as their usefulness for highly irradiated fuel reprocessing are underlined. (auth)

161 (JINR-P13-6014) ION SOURCE FOR RADIOACTIVE ELEMENTS. Piotrovski, A.; Raiko, V. I.; Tyrroff, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

A magnetron-type ion source for radioactive isotope separation is described. The efficiency exceeds 10% for a 10^{-9} to 10^{12} g radioactive probe separated together with a milligram amount of stable mass marker. The source is operated at temperatures of about 1000°C and the separation takes about 10 minutes. (auth)

162 (LB/G-2980) EXTRACTION OF URANIUM FROM SEAWATER. I. COPRECIPITATION OF URANIUM IN SEAWATER WITH METAL HYDROXIDES. Ogata, N. Translated by R. A. Scutt (Atomic Energy Research Establishment, Harwell, Eng.), from Nippon Genshiryoku Gakkaishi; 10: No. 12, 672-8 (1968). 15p. Dep. NTIS (U. S. Sales Only).

With the view to studying the possibility of separating uranium from seawater by coprecipitation, the carrier properties of ferric, aluminum, and titanium hydroxides were examined, with the following results: (1) The values of pH at which uranium started to coprecipitate with the carriers were 4.5 for ferric hydroxide, 5.0 for aluminum hydroxide, and 2.8 for titanium hydroxide. (2) Optimum pH values for decarbonated seawater to obtain maximum recovery of uranium were 8 to 9 for aluminum and ferric hydroxides, and 4.5 to 9 for titanium hydroxide with natural seawater; the values were appreciably lower for ferric and aluminum hydroxides; but unchanged for titanium hydroxide. (3) In the case of ferric and aluminum hydroxides, the coprecipitation ratios of uranium were much smaller in natural than in decarbonated seawater. With titanium hydroxide, however, uranium coprecipitated with equal ease in natural seawater and decarbonated seawater. (4) Uranium was effectively separated from the carriers by carbonate salt extraction but not by acid extraction. (auth)

163 (LB/G-2981) EXTRACTION OF URANIUM FROM SEAWATER. II. ADSORBENTS FOR EXTRACTION OF URANIUM FROM SEAWATER. Ogata, N.; Kakihana, H. Translated by R. A. Scutt (Atomic Energy Research Establishment, Harwell, Eng.), from Nippon Genshiryoku Gakkaishi; 11: No. 2, 82-7 (1969). 15p. Dep. NTIS (U. S. Sales Only).

About fifty insoluble compounds of titanium, aluminum, magnesium, calcium, silicon, zinc, chromium, lead, and tin were examined in a search for suitable adsorbents of uranium in seawater. The only materials that exhibited an effective uptake were titanium hydroxide, lead sulfide, and chromium hydroxide, the uptake capacities of which were 196, 134, 68 μg/g, respectively. While their uptake capacity was small, manganese dioxide, zinc hydroxide, and lead hydroxide also adsorbed uranium in the pH range of seawater. Ferric hydroxide, ferrous sulfide, ferric phosphate, tin sulfide, titanium hydroxide, and manganese oxide were found to be good adsorbents in acidified seawater, though acidification of seawater would not be practical in industrial scale operations. Tannic acid salts of magnesium, calcium, and titanium adsorbed uranium in seawater, but had the drawback of relatively large solubility. (auth)

164 (LB/G–2982) EXTRACTION OF URANIUM FROM SEAWATER. III. CONCENTRATION OF THE URANIUM IN WEAK URANIUM SOLUTIONS BY MEANS OF SURFACTANTS. Ogata, N.; Kakihana, H. Translated by R. A. Scutt (Atomic Energy Research Establishment, Harwell, Eng.), from Nippon Genshiryoku Gakkaishi; 11: No. 8, 469–76(1969). 19p. Dep. NTIS (U. S. Sales Only).

A study was made of foam separation with various kinds of surface active agents and adsorption separation with metallic soaps and laurylamine salts, for the purpose of concentrating trace amounts of U in various kinds of salt solutions and seawater. The optimum conditions were influenced by the chemical components of the solutions. The most effective methods brought to light were as follows: (1) Foam separation with laurylamine acetate on neutral solutions of various salts, alkylbenzylammonium chloride on weak alkali solution, and laurylbetain on acidic solution of nitrate and seawater. (2) Adsorption of U contained in seawater by Fe, Ti, and Zn soaps. In acidified seawater, it was adsorbed by Mg, Ti, and Ni soaps. (3) Adsorption of U in chloride, sulfate, and nitrate solutions by Ca soap. U in seawater was adsorbed only when acidified. (4) Adsorption of U in the various salt solutions by laurylamine phosphate. (auth)

165 (NIM–1205) ADSORPTION OF URANYL SPECIES ON PYROPHYLLITE, QUARTZ, AND ACID-TREATED SOUTH AFRICAN URANIUM ORES. A PRELIMINARY INVESTIGATION. Lombaard, Rita; Lovell, V. M.; Allison, S. A. (National Inst. for Metallurgy, Johannesburg (South Africa)). 16 Feb 1971. 21p. Dep. NTIS (U. S. Sales Only).

The adsorption of ionic species of uranium by pyrophyllite and quartz was investigated. A more detailed study of the adsorption and desorption of uranyl species (from sulfate solution) by ore from the Rössing deposit was also undertaken. Owing to poor reproducibility, the interpretation of the results was difficult. However, it was found that complete desorption of the uranium occurs after adsorption from solutions containing 8.5 ppM of uranium. Adsorption of uranyl species by Buffelsfontein ore was also investigated. It was concluded that the amounts of uranium that might be lost due to adsorption in the extraction process were probably very small, amounting to less than 0.6% of the head value of the uranium. (auth)

166 (NP–19029) FRONTAL ISOTOPIC CHROMATOGRAPHY: APPLICATION TO BORON. Chambu, Claude (Paris Univ. (France). Faculte des Sciences). [1968]. 123p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Frontal isotopic chromatography is presented as an amplified method of an elementary phenomenon. It was found that the factor of amplification is affected by chromatographic variables such as temperature, length of column, or velocity of sample; but in each case it can be expressed in the form of a ratio of the quantity of gas necessary to the saturation of the phase to the quantity of gas enriched in one of the isotopes. The factor of amplification is expressed as a function of the elementary parameters governing chromatography. The theoretical expression makes clear the effects of molecular diffusion, of the geometry of filling, and of the kinetics of isotopic exchange. It is suggested that the proposed and verified models are applicable not only to the isotopes of boron, but to all cases of frontal isotopic chromatography. The simplicity of putting the technique into operation renders it capable of application to industrial isotopic separation, the column being considered a unit of an enrichment cascade. (tr-auth)

167 (ORNL–4724) FORMATION OF THIRD PHASES AND THE EFFECT OF TEMPERATURE ON THE DISTRIBUTION OF PLUTONIUM AND URANIUM IN EXTRACTIONS BY TRI-n-BUTYL PHOSPHATE. Horner, D. E. (Oak Ridge National Lab., Tenn.). Sep 1971. Contract W-7405-eng-26. 32p. Dep. NTIS.

The results obtained by various investigators in studies of the effect of temperature on the distribution of plutonium and uranium in extractions by tri-n-butyl phosphate (TBP) are summarized. The results of all the tests of uranium extraction from 0.07 to 10 M HNO_3 solutions show that the extraction coefficients decrease as the temperature is increased. The results of all the tests of Pu(IV) extraction from nitric acid solutions with a concentration of 0.5 M or less show that the extraction coefficients for Pu(IV) also decrease as the temperature is increased; however, at higher nitric acid concentrations, there is some disagreement among data from different sources. The results of recent tests with 1 and 4 M HNO_3 disagree with those obtained in previous investigations in that they show little or no effect of temperature on the plutonium extraction coefficients in the temperature range 30 to 60°C. The maximum organic-phase plutonium concentration in TBP–n-dodecane that is obtainable without the formation of a third phase was shown to increase as the ionic strength of the aqueous phase in equilibrium with the organic phase was increased. For example, over the ionic strength range of 2.0 to 9.5, the allowable plutonium concentration increased from about 20 to 40 g/liter with 15% TBP, and increased from about 33 to 62 g/liter with 30% TBP, at room temperature (~23°C). In tests in which third phases were formed, the third phase disappeared in each case when the temperature was moderately increased. At 40°C, a loading of up to 68 g of plutonium per liter was obtained in 15% TBP, corresponding to about the theoretical maximum ratio of 0.5 mole of plutonium per mole of TBP. (auth)

168 SOLVENT EXTRACTION SEPARATIONS OF THE LANTHANIDES AND SELECTED METAL IONS WITH 1,1,1,2,2,3,3-HEPTAFLUORO-7,7-DIMETHYL-4,6-OCTANEDIONE. Sweet, Thomas R.; Brengartner, Dennis (Ohio State Univ., Columbus). Anal. Chim. Acta; 56: No. 1, 39-44(Aug 1971).

1,1,1,2,2,3,3-Heptafluoro-7,7-dimethyl-4,6-octanedione (0.1 M) in benzene was used for the solvent extraction separation of the lanthanides and other selected metals from an aqueous phase containing 1 M total acetate in the pH range 1 to 7. A series of batch extractions was performed with the various metals and percent extraction versus pH curves were constructed. The lanthanides studied were completely extracted in the pH range of 5.7 to 7.0 in less than 4 min. Of the other metals that were investigated, only iron(III) and copper(II) were completely extracted. While the separation factors achieved for adjacent lanthanides were not large, the countercurrent distribution studies showed that such separations are feasible. (auth)

169 KETONE EXTRACTION OF CHLORIDE–BISULFATE COMPLEXES OF SCANDIUM. Zangen, M.; Rafaeloff, R. (Soreq Nuclear Research Center, Yavne, Israel). Radiochim. Acta; 16: No. 1, 28-9(Aug 1971).

The partition of scandium between methyl ethyl ketone or methyl isobutyl ketone and aqueous chloride–bisulfate solutions of constant ionic strength = 5.0 was determined radiometrically as a function of aqueous acidity and chloride/bisulfate ratio. A shallow maximum was found at 2M chloride. The dependence of the distribution ratio on the aqueous acidity was less than first power. Results can be interpreted by the formation of the following complexes in the organic phase (where Kt represents a ketone molecule and KtH^+ a solvated hydroxonium ion): $KtH^+ \cdot ScCl_4^-$, $KtH^+ \cdot ScCl_3(HSO_4)^-$, $KtH^+ \cdot Sc(HSO_4)_4^-$, $ScCl_3Kt_p$, and $Sc(HSO_4)_3Kt_p$. Formation constants for these complexes are calculated. (auth)

170 GLASS AS A COATING MATERIAL FOR RADIOACTIVE WASTES. Bonniaud, R.; Sombret, C. (CEA, Bagnols-sur-Ceze, France). Verres Refract.; 25: No. 2, 59-70(Mar 1971). (In French).

The possibility of embedding in a glassy matrix irradiated fuel waste, mainly consisting of burned alumina with fluorides still adhering to it, was studied. Trials were performed on the laboratory scale to test the coating material (a phosphate or a silicate-phosphate glass, having a viscosity less than 200 poises at 1000°C) and to investigate the application of the proposed method by heating a mixture of coarsely ground glass and fuel waste. It was found that the properties of the product were improved by the glass coating. Means for stabilizing the volatile fluorides which affect the homogeneity of the glassy matrix are discussed. Two applications are investigated: a semicontinuous process, in which one device was provided for all the stages in the process, and a continuous process using two different devices. A pilot–plant consisting of a working–cell of the Piver type is described. (auth)

171 LES ISOTOPES. (Isotopes). 2. ed. Rocchiccioli-Deltcheff, Claude. Paris, France; Presses Universitaires de France (1971). 128p.

The history of the discovery of radioisotopes, the various iso-

tope effects and separations, and the preparation of radioactive isotopes are briefly reviewed. Tracer techniques are studied and the various applications of radioisotopes examined. (France)

172 PERFORMANCE OF TYPE CP-20 CHARCOAL-IMPREGNATED FILTER PAPER FOR COLLECTING AIRBORNE RADIOIODINE. Naritomi, Mitsuo; Fukuda, Seiji (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 13: No. 4, 174-81(Apr 1971). (In Japanese).

Two types of charcoal-impregnated filter paper, CP-20A and CP-20B, manufactured by Toyo Filter Paper Co., Ltd., Tokyo were tested for their collection performance on airborne iodine generated during ^{131}I production at the Isotope Test Production Plant, which is successively filtered through traps in the cell and through two installed air cleaning systems. In order to observe the effect brought upon the collecting efficiency by differences in charcoal granule size, the CP-20A and -20B were impregnated with activated charcoal granules of about 2 μ and about 70 μ in average diameter. The experimental results and discussions on the dependence of collecting efficiency on (1) the nature of the air-borne iodine, (2) the relative humidity of the sampling air, (3) the sampling period, and (4) the face velocity are described. In general, better performance for collecting airborne iodine was shown by the CP-20B compared with the CP-20A. (auth)

173 RAPID SEPARATION OF ^{89}Sr AND ^{90}Sr FROM ^{60}Co AND FISSION PRODUCTS. Stoeppler, Markus (Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem.; 253: No. 1, 35-6(1971). (In German).

A method for rapid separation of ^{89}Sr and ^{90}Sr from ^{60}Co and fission products is described. The isotopes are separated by ion exchange columns. A decontamination factor of $>10^5$ was obtained for cobalt. ^{54}Mn also is removed almost quantitatively. (H.B.G.)

174 DILUTED TRIBUTYL PHOSPHATE AS AN EXTRACTANT FOR SILVER. Yadav, A. A.; Khopkar, S. M. (Indian Inst. of Tech., Bombay). Mikrochim. Acta; No. 3, 464-70 (1971).

A new method was developed for the rapid solvent extraction of silver with dilute tributyl phosphate. Thus 40% TBP in butanol quantitatively extracts silver (49.8 μg) from 1M nitric acid that is 2M in lithium nitrate as salting-out agent. Silver is stripped with dilute ammonia and is determined photometrically at 495 nm as its red-violet complex with p-diethylaminobenzylidenerhodanine. The effects of acidity, varying TBP concentration, and a salting-out agent were studied. The probable composition of the extractable species is thought to be $AgNO_3 \cdot (TBP)_3$ or $HAg(NO_3)_2(TBP)_3$. Silver can be extracted in the presence of a large number of elements with which it is associated in alloys, minerals, or fission products. The method is simple, selective, and rapid and needs only 30 minutes for the separation and determination. (auth)

175 COMPARATIVE EXTRACTION OF SELECTED M(III) CATIONS BY $(2\text{-}C_2H_5.C_6H_{12}O)PO(OH)_2$ AND $(2\text{-}C_2H_5.C_6H_{12})PO(OH)_2$. Lewey, S.; Mason, G. W.; Peppard, D. F. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem.; 33: No. 8, 2531-9(Aug 1971).

The extraction of Eu^{3+} and Am^{3+} by a benzene solution of H_2Y from various aqueous chloride phases, where H_2Y is $(2\text{-}C_2H_5 \cdot C_6H_{12}O)PO(OH)_2$, H_2MEHP, or $(2\text{-}C_2H_5 \cdot C_6H_{12})PO(OH)_2$, $H_2[(EH)P]$, was studied. From an aqueous 1.0F (NaCl + HCl) phase the extraction may be expressed mathematically as: $H_2[(EH)P]$: $K = K_3F^2/[H^+]^3$, H_2MEHP: $K = K_3F/[H^+]^2$, high acid and $K = K_3F/[H^+]$, low acid. The extraction of Eu^{3+} and Am^{3+} into a benzene solution of $(n\text{-}C_8H_{17}O)_2PO(OH)$, HDOP, from various aqueous chloride phases was studied in order to elucidate the behavior in H_2MEHP systems. Plots of log K vs Z for the 15 lanthanides(III) in the 0.11F H_2MEHP (benzene) vs 0.50F HCl system and the 0.11F $H_2[(EH)P]$ (benzene) vs 0.25F HCl clearly illustrate the "tetrad effect." (auth)

176 EXTRACTION BY QUATERNARY AMMONIUM SALTS OF HIGH MOLECULAR WEIGHT OF HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID AND ITS COMPLEXES WITH TRIVALENT LANTHANIDES AND ACTINIDES. I. EXTRACTION OF THE COMPLEXING AGENT. Zaman, N.; Merciny, E.; Duyckaerts, G. (Univ., Liege). Anal. Chim. Acta; 56: No. 2, 261-9(Sep 1971). (In French).

The extraction of hydroxyethylethylenediaminetriacetic acid was carried out at different pH values of the aqueous phase with quaternary ammonium chloride in benzene; in all cases, the extraction of HEDTA in the organic phase seems to be an ion-exchange phenomenon. The distribution results show that the quaternary ammonium salt is polymeric in the organic phase and that, per molecule, only one chloride ion is exchanged with the acid molecule. The average polymerization factor was found to be 2.75. Extraction equilibrium constants are determined with Aliquat 336. (auth)

177 EXTRACTION BY QUATERNARY AMMONIUM SALTS OF HIGH MOLECULAR WEIGHT OF HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID AND ITS COMPLEXES WITH TRIVALENT LANTHANIDES AND ACTINIDES. II. EXTRACTION OF AMERICIUM AND CURIUM. Zaman, N.; Merciny, E.; Duyckaerts, G. (Univ., Liege). Anal. Chim. Acta; 56: No. 2, 271-8(Sep 1971). (In French).

The extraction of the 1 : 2 complexes formed between the trivalent actinides, americium and curium, and HEDTA is carried out, at different pH values of the aqueous phase with tricaprylmethylammonium chloride in benzene. The charge and the stability constants of the 1 : 2 complexes $MeH_{3-m}Y_2^{m-}$ are determined. In certain experimental conditions, separation factors as high as seven can be obtained for the two actinides. (auth)

178 INVESTIGATIONS ON THE FIXATION OF FISSION PRODUCT RARE GASES IN LINDE MOLECULAR SIEVES. Schneider, J.; Tamberg, T. (Hahn-Meitner Inst. fuer Kernforschung, Berlin). Atomkernenergie; 18: No. 1, 88(Aug 1971). (In German).

As a potential method for final deposition of radioactive krypton and xenon produced during fuel reprocessing, absorption of the rare gases in Linde molecular sieves with subsequent fixation through blocking of the pores was studied. The sieves absorbed 60 to 80% of the gases. Effective blocking of the pores could not be achieved by either large ions or various amines. Partially successful was saturation of the sieves with Ag ions prior to gas absorption, followed by fixation through CH_3I. From the thus treated sieves, release of radioactive gases was delayed. Ethyl iodide showed a similar effect. (H.B.G.)

179 METHOD OF RECOVERING PLUTONIUM AND URANIUM FROM FISSION PRODUCTS BY LIQUID–LIQUID EXTRACTION. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,247,248. 22 Sep 1971. Priority date 13 Mar 1968, Germany.

A method is described for recovering Pu and U from fission products by liquid–liquid extraction. An aqueous solution of Pu, U, and fission products is contacted with an organic extraction agent, such as TBP, and then re-extracted, with HNO_3. The organic phase is then treated with a tetravalent U solution to reduce the tetravalent plutonium therein to trivalent plutonium and to remove the plutonium as such from the organic phase. (M.C.G.)

180 COMPARISON OF SOME MONOACIDIC ORGANOPHOSPHORUS ESTERS AS LANTHANIDE–ACTINIDE EXTRACTORS AND SEPARATORS. Weaver, Boyd; Shoun, R. R. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 33: No. 6, 1909-17 (Jun 1971).

Comparison of di(2-ethylhexyl)phosphoric acid (DEHPA), 2-ethylhexyl phenylphosphonic acid (HEH[ΦP]), and 1-methylheptyl phenylphosphonic acid (HMeH[ΦP]) in an aliphatic and an aromatic diluent as intragroup separating agents for trivalent lanthanides and actinides shows some important advantages of HMeH[ΦP]. In extractive power, HMeH[ΦP] is intermediate to the other compounds. In several separations systems HMeH[ΦP] is at least twice as effective as DEHPA and significantly better than HEH[ΦP] for separation of tracer-level Eu from Ce, and its advantage for separating Cf from Cm is nearly as great. Neither of the phosphonic acids is suitable for separating natural lanthanides at the usual high concentrations because of solubility limitations. Extractions of these elements frequently deviate from the theoretical third-power dependence on extractant concentration and inverse third-power dependence on acid concentration. Extractant concentration dependence varies with extractant and diluent. Acid concentration dependence varies somewhat with extractant and diluent, and much more with element and aqueous acid. A process used successfully for separating Cf from Cm is based on extraction by an aliphatic solution of DEHPA from HCl. More effective separation can be obtained with HMeH[ΦP]. With HEH[ΦP] or HMeH[ΦP], HNO_3 can be substituted for HCl, giving a separation superior to that with the DEHPA–HCl system, provided that solubility limitations are not exceeded. (auth) (UK)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 28, 156, 210, 220, 223, 356, and 1323.

181 (BNWL-1613) RADIOLOGICAL STATUS OF THE GROUNDWATER BENEATH THE HANFORD PROJECT, JULY-DECEMBER 1970. Essig, T. H. (Battelle Pacific Northwest Labs., Richland, Wash.). Sep 1971. Contract AT(45-1)-1830. 25p. Dep. NTIS.

An evaluation of $^{106}Ru-Rh$ and ^{3}H concentrations measured in the unconfined groundwater during the second half of 1970 shows that the zones of detectable contamination extend in an easterly to southeasterly direction from 200-E Area as observed in the past. For the first time, ^{3}H concentrations were measured over a geographically extensive area in the vicinity of the 100 Areas. The few locations for which average groundwater concentrations exceeded the Concentration Guide (CG) for ^{106}Ru were all within either 200-E or 200-W Areas. Water from only one 600 Area well located outside limited area fences (well 699-35-70) indicated a ^{3}H concentration greater than the Concentration Guide. Gross beta activity concentrations in the groundwater beneath the 100 Areas decreased such that the only samples showing detectable beta activity were from wells located at 100-N Area. Concentrations of uranium, the principal radionuclide observed in 300 Area groundwater, averaged less than 0.5 pCi/ml (<3 percent CG). Although water samples from several wells with piezometer tubes extending to deep aquifers were obtained and analyzed, all such samples had gross beta concentrations less than the analytical limit (0.2 pCi/ml). Nitrate ion concentrations greater than 10 percent of the Public Health Service (PHS) recommended drinking water standard of 45 ppM were observed in most groundwater samples from wells within and surrounding the 200 and 300 Areas. However, groundwater from these zones is not consumed by humans or animals. (auth)

182 (NYO-2955-25) FIXATION OF ^{137}Cs BY SOIL CLAYS. Final Report. Frink, Charles R. (Connecticut Agricultural Experiment Station, New Haven). 30 Sep 1971. Contract AT(30-1)-2955. 18p. Dep. NTIS.

The effects of Cs sorption on the interlayer collapse in dioctahedral vermiculite in Connecticut soils were studied and compared with the collapse with di- and trioctahedral vermiculites obtained by successive removal of interlayer K from muscovite and biotite. The sorption and fixation of Cs by whole soils and how these characteristics are related to the mineralogy of the soils were investigated using ^{137}Cs tracers. It was concluded that the sorption and fixation characteristics of the whole soil can be predicted from the mineralogy of the clay fraction. (L.C.L.)

183 MEASUREMENT WITH RADIOACTIVE SOURCES OF SOIL MOISTURE AND SOIL DENSITY IN DIFFERENTLY TREATED PASTURES. Rieder, Johann B. (Technische Univ., Munich). Bayer. Landwirt. Jahrb.; 48: No. 3, 259-305(1971). (In German).

Soil moisture was measured with a ^{241}Am-beryllium neutron source. A lithium-glass scintillation crystal served as a detector for thermal neutrons. Soil density was measured with a ^{137}Cs source. The measuring devices were contained in one probe. In various pasture areas both soil moisture and density were studied with respect to rolling, cutting, grazing, and soil type. Soil moisture and density in grazed pastures was about 5% higher than in non-grazed areas. (39 references) (H.B.G.)

184 VERTICAL GRADIENTS OF HEAT PRODUCTION IN THE CONTINENTAL CRUST. 1. THEORETICAL DETECTABILITY FROM NEAR-SURFACE MEASUREMENTS. Lachenbruch, Arthur H. (Geological Survey, Menlo Park, Calif.). J. Geophys. Res.; 76: No. 17, 3842-51(10 Jun 1971).

The linear relation between heat flow and heat production suggests that in a gross sense the vertical distribution of crustal heat production beneath granitic rocks has a simple generalized form. Knowledge of the vertical gradient of heat production near the surface would permit selection between alternative simple models. However, attempts to determine a generalized gradient from heat-production measurements from boreholes are complicated by the occurrence of inhomogeneities on all observable scales. Variations in heat production typically observed on the hand-sample scale preclude meaningful estimates (even of the sign) of the generalized gradient in holes a few hundred meters deep, the depth typically drilled for heat-flow-heat-production measurements. In holes 3 km deep, the uncertainty in the gradient due to small-scale perturbations is generally reduced to acceptable levels with 100 or so samples. However, perturbations with wavelengths greater than 1 km and amplitudes sufficiently small to permit the linear heat-flow relation, can still preclude meaningful estimates of gradient if the phase is unfavorable. Confident determinations of the trend of heat production with depth in granitic rock will require observations in several holes to depths of a few kilometers or in very large numbers of holes drilled to lesser depths. (auth)

185 VERTICAL GRADIENTS OF HEAT PRODUCTION IN THE CONTINENTAL CRUST. 2. SOME ESTIMATES FROM BOREHOLE DATA. Lachenbruch, Arthur H. (Geological Survey, Menlo Park, Calif.); Bunker, Carl M. J. Geophys. Res.; 76: No. 17, 3852-60(10 Jun 1971).

Vertical gradients of heat production were estimated from measurements on samples from eight boreholes in granitic rocks. Samples contained from 10 to 100 specimens, and the borehole depths range from 350 m to 3 km. For holes less than 1 km deep the scatter of results is consistent with theoretical expectations based on known small-scale inhomogeneities. Gradient estimates from the deeper holes are not strongly influenced by such inhomogeneities, but their uncertainty cannot be evaluated statistically because of the possible effects of small perturbations of longer wavelength. The data suggest a general decrease in heat production with depth in the granitic rocks of a magnitude consistent with the exponential source model, although alternate models are not precluded. A 3-km hole in schist did not exhibit this trend, consistent with the view that upward concentration of sources occurred in the presence of a melted phase. As uncertainties in the numerical results are large and difficult to evaluate, many more analyses will be needed to establish vertical heat-production trends with confidence. (auth)

186 LABORATORY DETERMINATION OF SOIL DENSITY USING GAMMA RAY ATTENUATION. Sastry, B. S.; Sethuraman, W.; Appalacharyulu, K.; Sheel, Om; Banerji, K. C. (Fertilizer Corp. of India Ltd., Sindri). Technology (Sindri); 7: No. 3, 115-19(Jul-Sep 1970).

Nuclear methods for determining soil density and moisture content are gaining importance. The applicability of gamma radiation absorption in soils for the bulk density determination in the laboratory was investigated using a NaI(Tl) scintillation spectrometer. Also, the variation in transmission of gamma radiation through soils was studied with the variation in moisture content. (auth)

187 COMBINED INTERPRETATION OF THE DIAGRAMS OF SELF-POLARIZATION POTENTIALS AND NATURAL RADIOACTIVITY. Vendel'shtein, B. Yu.; Mancheva, N. V.; Petersil'e, V. I. Tr., Mosk. Inst. Neftekhim. Gazov. Prom.; No. 89, 72-8(1969). (In Russian).

The diffusion-adsorption activity of rocks and their specific natural radioactivity indicate the presence of a highly-dispersed clayey material, and determine the basic form of the potential curves of self-polarization and natural radioactivity. The natural radioactivity of rocks depends not only upon their clay content but also on the presence in the rocks of minerals and compounds with anomalous radioactivity. Anomalous potentials of self-polarization in individual strata may contain a component arising from diffusion emf. The effect of the strata intensity and the borehole conditions on the magnitude of the anomaly in gamma-method curves and the potentials of self-polarization are different. The open porosity coefficient of clay materials was evaluated using the data of the combined interpretation of diagrams of potentials of self-polarization and the gamma method. (K.S.W.)

188 RADIONUCLIDE DATING IN MARINE SEDIMENTATION RESEARCH. Chesselet, R. (CNRS, Gif-sur-Yvette, France). Houille Blanche; 25: No. 8, 765-72(1970). (In French). (CONF-691135-1).

From Conference on the applications of radioelements in sedimentology; Paris, France (18 Nov 1969).

A large number of problems in present day geochemistry and geophysics depend on measured sedimentation rates on the continental shelves and in the great ocean depths. The widespread use made of dating methods based on the properties of certain radioactive nuclides in sedimentation research has greatly contributed to a clearer understanding of a certain number of vitally important geo-scientific problems, examples of which include problems associated with the formation of the earths crust, the ages of major magnetic inversions, sea level fluctuations due to

climate changes, the abundance of elements in the marine environment, the evaluation of quantities of matter from space accumulating on earth, etc. Dating methods based on ^{14}C disequilibria in the uranium and thorium families, potassium/argon, fission traces, and thermoluminescence are discussed. The general outlines of the methods used and their special applications are discussed. (auth) (France)

189 QUALITY CONTROL OF SOILS IN BANKING USING THE RADIOISOTOPE APPARATUS. 2. Tanaka, Kunihiro (Kajima Construction Co. Ltd., Tokyo). Kajima Kensetsu Gijutsu Kenkyusho Nempo; 18: 107-14(Oct 1970). (In Japanese).

Measurement of soil density by a nuclear density probe and of soil moisture-content by a neutron moisture probe require less time than measurements by the dry sand method, and will be widely used in the future for quality control of soils in banks. Since the data obtained has wide variations due to the operating characteristics of the radiometric apparatus, a statistical method for treating the data is discussed. Also a statistical sampling method which can be used effectively for quality control of banked soils is presented. (auth) (Japan)

190 PROBLEM OF THE CO-RELATION BETWEEN THE SPECIFIC RADIOACTIVITY OF SURFACE WATER AND THE RESIDUE AFTER HEATING. Kwapulinski, J.; Trzcionka, T. Gaz, Woda Tech. Sanit.; 44: 203-5(1970). (In Polish).

The results of surface water tests in the Katowice region are given. The correlation between the specific radioactivity of the water and the residue after heating has not been stated. (auth) (NSA of Poland)

191 GAMMA-RAY PROPERTIES OF DISPERSIVE SOILS. Zvol'skii, S. T.; Vovk, P. K. (Inst. of Geology, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 2, 133-5(Feb 1971). (In Ukrainian).

Data are given on gamma-ray properties of dispersive soils: values of average weight and atomic numbers and atomic weights of separate varieties of dispersive soils; Compton scattering cross sections; photoelectric absorption cross sections and complete sections of interaction gamma-quantum of energies 0.1 to 2 MeV with these soils energy absorption of gamma quanta in this region of energies; and average energies of multiply scattered cesium-137 and cobalt-60 sources in dispersive soils. (auth)

192 CARBONATITES OF SEVATHUR AND JOKIPATTI, MADRAS STATE, INDIA. Udas, G. R.; Krishnamurthy, P. (Univ. of Saugar, India). Proc. Indian Nat. Sci. Acad., Part A; 36: No. 5, 331-43(Sep 1970). (CONF-681088-6).

From Symposium on the geology and mineralogy of atomic mineral deposits and their development for use in the nuclear power program; New Delhi, India (14 Oct 1968).

The geologic setting, mineralogy, and geochemistry of the economic minerals of the carbonatites of Sevathur and Jokipatti, Madras state are described. The carbonatites were apparently emplaced 720 ± 30 million years ago along the boundary fault zone between orogenic belts and were associated with syenites. Pyroxenites and fenites occur within the oval-shaped aureole of fenitization surrounding the carbonatite body. The carbonatites are composed of sövites in the outer periphery and beforsite in the inner core, with ankeritic carbonatite forming a thin transitional zone between the two. The carbonatites are characterized by fairly high radioactivity (0.01 to 0.04% U_3O_8), enrichment in ThO_2, Sr, La, Ce, Nb, and Ba and the expected magnitude of $^{87}Sr/^{86}Sr$ (0.705 ± 0.0007). The high phosphorous content of the rocks (1.21 to 14.22% P_2O_5) and the soils (4 to 11% P_2O_5) makes the area an attractive source of raw materials for the fertilizer industry. Possible structure and age clues for locating carbonatites in the southern peninsula of India are indicated. (auth)

193 ALPHA-RECOIL ^{234}Th: DISSOLUTION INTO WATER AND THE $^{234}U/^{238}U$ DISEQUILIBRIUM IN NATURE. Kigoshi, Kunihiko (Gakushuin Univ., Tokyo). Science; 173: No. 3991, 47-8(2 Jul 1971).

The rate of ejection of alpha-recoil thorium-234 into solution from the surface of zircon sand gives an alpha-recoil range of 550 Å. The alpha-recoil thorium-234 atoms ejected into the groundwater may supply excess uranium-234. In pelagic sediments, ejected alpha-recoil thorium-234 may contribute to the supply of mobile uranium-234 in the sedimentary column. (auth)

194 PHYSICS APPLIED TO ARCHAEOLOGY. I. DATING. Aitken, M. J. (Oxford Univ.). Rep. Progr. Phys.; 33: No. 10, 941-1000(Oct 1970).

An account is given of the three main chronological applications of physics in archaeology: radiocarbon dating, thermoluminescence dating and archaeomagnetism. In addition the following techniques are outlined: potassium–argon dating, uranium series dating (including ionium dating), fission track dating and dating by chemical change. Some mention of dendrochronology and varve chronology is included in the section on radiocarbon. 236 references. (auth)

Meteorology

Refer also to abstract 156.

195 (COO-2053-5) ENTRAINMENT OF STACK GASES BY BUILDINGS OF ROUNDED GEOMETRY. Meroney, Robert N.; Symes, C. R. (Colorado State Univ., Fort Collins). [1970]. Contract AT(11-1)-2053. 4p. Dep. NTIS.

The unusual shape of some nuclear reactor containment vessels used to prevent the release of gaseous or solid radioactive material into the atmosphere prompted a wind tunnel study of how these building shapes affect the atmospheric flow of stack-released effluents. One cylindrical and 4 cone frustrum models situated in a shear layer of wind tunnel flow were tested using ^{85}Kr released from various positions on the models at a rate that would simulate the "leakage" condition from a containment vessel. The experimental data led to the following conclusions. Model shape has very little effect on final plume height (i.e., plume height in the far wake) but causes marked changes in plume width growth. Final plume height was about twice the model height and total plume width was greater than five diameters by the time the near wake region was reached and plume width growth decreased with decreasing model projected area. Ground concentration decreases linearly with downstream distance (on log–log plot) at an almost constant slope in the near wake and far wake region. The average slope was –0.95 for all models and all release configurations. For top and side top releases lofting of the plume due to frustum taper caused decreased ground concentrations for the frustums (cf. cylinder) for $X/D < 10$. Releases from the side top and side bottom had little effect on the final plume height. Bottom releases caused the plumes to rise 1½ to 2 times faster than top releases in the cavity and near wake regions. Releases directly into the cavity ($\theta = 0^0$) had the fastest plume rise rate. Loss of the upstream part of the horseshoe vortex system due to increasing model taper was believed responsible for the changes in the diffusion character for the side bottom $\theta = 0^0$ release. The 1% increase in drag coefficient of frustum 3 over frustum 4 and the higher defect parameter values of frustum 3 are also attributed to this effect. The turbulent field caused by the model presence decays very quickly in the transverse direction (the background level is reached within one diameter) whereas there is much slower decay in the downstream direction (virtually no decay until after one diameter downstream). (L.C.L.)

196 (EERL-71-3) RADIOLOGICAL SURVEY AROUND POWER PLANTS USING FOSSIL FUEL. Bedrosian, P. H.; Easterly, D. G.; Cummings, S. L. (Eastern Environmental Radiation Lab., Montgomery, Ala. Environmental Protection Agency, Rockville, Md. Office of Research and Monitoring). Jul 1970. 17p.

Release of radioactive materials in fly ash discharged from steam power plants burning fossil fuel, particularly coal, was investigated. Air sampling techniques were developed to provide useful data for use in estimating dose to critical organs, primarily lung, in man. Procedures are described for collecting air samples at environmental sites remote from the power plant facility. (auth)

197 (LIB/Trans-382) THE EFFECT OF POOR EXCHANGE (WEAK VELOCITY) METEOROLOGICAL CONDITIONS ON THE RADIATION EXPOSURE IN THE ENVIRONMENT OF NUCLEAR PLANTS. Koenig, L. A. (Kernforschungszentrum, Karlsruhe (West Germany)). Translated by I. A. Mumme (Australian Atomic Energy Commission), from report KFK-1336, 13p. Dep. NTIS (U. S. Sales Only).

An abstract of this report, prepared from the original, appeared as NSA 25: 32084 (1971). (Australia)

198 (UCRL-73469) SHOCK-ISOLATION SYSTEM FOR 22 FEET OF VERTICAL GROUND MOTION. Jackson, E. C.; Miller, A. B.; Bernreuter, D. L. (California Univ., Livermore. Lawrence Radiation Lab.). 1 Oct 1971. 8p. (CONF-711110-1). Dep. NTIS.

From forty-second shock and vibration symposium; Key West, Fla. (2 Nov 1971).

Shock isolation of fragile equipment from severe ground motion induced by underground nuclear detonations requires special techniques for inexpensive, reliable performance. Two shock-

mitigation systems that have been used successfully for the past several years are described. These systems have allowed equipment to be located closer to the explosive source, resulting in considerable savings in diagnostic cable costs. A new system was designed for even more severe ground motion. The new design, the instrumented testing program, and test results are discussed. (auth)

199 RADIOACTIVE FALLOUT IN PRAGUE, 1969. Spurny, Kvetoslav; Holy, Evzen (Ustav Fyzikalni Chemie, Prague). Zdrav. Tech. Vzduchotech.; 13: No. 3, 141-3(1970). (In Czech).

Further results gained in the measurement of radioactive fallout in the year 1969 are given. Radioactive fallout in the course of the whole year and the influence of Chinese nuclear weapons tests are indicated. (auth)

200 RADIOACTIVE DUST FALLOUT IN BHAVNAGAR AREA IN MAY 1966. Sharma, M. C. Sci. Cult. (Calcutta); 37: No. 1, 59-60(Jan 1971).

Comments are given on a paper previously published in NSA as 23: 17583 in which attempts were made to correlate the increased radioactivity observed over Bhavnagar on May 19 to 31, 1966 as a result of the Chinese nuclear explosion on May 9, 1966, with the meteorological conditions over North India during that period. (P.C.H.)

201 UPPER PORTION OF THE HADLEY CELL CIRCULATION AS DEDUCED FROM THE 1968 FRENCH AND CHINESE NUCLEAR TESTS. Telegadas, K. (Air Resources Lab., Silver Spring, Md.). J. Geophys. Res.; 76: No. 21, 5018-24(20 Jul 1971).

French and Chinese nuclear testing in 1968 provided an opportunity for studying stratospheric transport processes. The French tests of August and September 1968 and the Chinese test of December 1968 provided radioactive tracers to follow air motions in the lower stratosphere of each hemisphere. The two sources are readily distinguishable by fission product ratios (e.g., $^{95}Zr/^{144}Ce$). Information on interhemispheric exchange in the upper troposphere and lower stratosphere has been developed by the analysis of air-filter samples obtained by aircraft and balloons. The meridional transport of radioactive debris into the lower equatorial stratosphere from two sources is qualitatively explained by a mean meridional circulation superimposed on large-scale mixing processes. It is further suggested that the mean circulation is an extension of the tropospheric Hadley Cell into the lower stratosphere. (auth)

202 MEASUREMENTS ON THE RELEASE OF GASEOUS ACTIVITY FROM A SHORT STACK. Rodliffe, R. S.; Fraser, A. J. (Central Electricity Generating Board, Berkeley, Eng.). Atmos. Environ.; 5: No. 4, 193-208(Apr 1971).

The behaviour of gaseous effluents released from a short stack at Hinkley Point "A" Nuclear Power Station was examined using argon-41, produced in the shield-cooling air, as a tracer. The rate of release of activity from the stack was determined and the resulting ground-level gamma fluxes were measured and correlated with wind speed and direction. The results are identified with two types of plume behaviour characterized by the ability of the effluent to penetrate the shear and wake region over the building. If the effluent does penetrate this region an elevated plume is formed, apparently unaffected by surrounding buildings; otherwise the effluent is entrained into the low-pressure field above and in the lee of the building, where rapid mixing occurs and a large area of the building appears to emit the plume. At low wind speeds the observed gamma fluxes were found to be roughly independent of wind speed whilst at high wind speeds the fluxes exhibited an inverse dependence on wind speed and could be associated with a uniform distribution of effluent within a 70 m radius semi-cylinder with its axis at ground level and extending from the building to infinity downwind. The results were compared with a simple model which assumes a gaussian distribution of wind speeds and a "switch" from the elevated plume to entrainment at a critical wind speed. Good agreement was obtained. Values of the ratio of efflux velocity to critical wind speed were dependent on direction and were in the range 1.5 to 3.0. (UK)

203 INDUCED AIRBORNE RADIOACTIVITY AT PRAGUE-BULOVKA DURING THE YEAR 1970. Behounek, Frantisek; Matouskova, Jirina (Nuclear Research Inst., Prague). Jad. Energ.; 17: No. 5, 146-9(May 1971).

The annual results found at Prague-Bulovka for the ground-level atmospheric radioactivity were compared to those from some other European stations along with the gross beta radioactivity. Similar features were found and the presence of short-lived nuclides produced by nuclear explosions in the southern hemisphere and vented underground explosions is discussed. The importance of continuous monitoring of the ground-level air for radioactivity in the environmental survey of nuclear installations is emphasized. (auth)

204 ESTIMATE OF THE ATMOSPHERIC RADIOACTIVITY IN THE CZECH SSR FOR THE YEARS 1968 TO 1969. Kolarova, Hana; Santroch, Jaroslav. Meteorol. Zpr.; 23: No. 5, 130-40 (31 Oct 1970). (In Czech).

The results of monitoring the total beta radioactivity of the air, as well as the values for the monthly, weekly, and daily fallout, are presented for the years 1968 to 1969. A brief meteorological analysis of the extremes of the atmospheric radioactivity is included. (tr-auth)

Mineralogy and Exploration

205 (RT/GEO-70(6)) URANIFEROUS MINERALIZATIONS OF THE BELVISO VALLEY. Mittempergher, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 11p. (In Italian). INIS.

A description is given of the U ore bodies in the Belviso Valley (Lombard Alps) and of CNEN investigations of these ore bodies. (INIS)

206 DISTRIBUTION OF URANIUM IN SOME ITALIAN DEPOSITS OF LIGNITE. Nascimben, P. (CNEN, Rome). Ind. Mineraria; 21: 1-27(1970). (In Italian).

A survey was conducted on some Italian lignite deposits in order to determine the uranium content and distribution. To this purpose, geological and radiometric field surveys were supplemented by 548 laboratory analyses for U_3O_8 in lignite ashes. By means of these analyses, the content of U_3O_8 dealing with lignite samples was determined. It was found that about 12,000 tons of U_3O_8 are contained in the lignites of some important deposits. About 90% of this potential is located in the Sulcis area (Sardinia), where the U_3O_8 content (in lignites and in ashes) is substantially higher than that found in the other major lignite deposits. Because of the low U_3O_8 content found in the examined samples, none of the Italian lignite deposits can be regarded as uranium-bearing formations. Furthermore, at the present state of technological progress, uranium extraction from the ashes, as by-product of lignite burning, is not feasible, because of the high cost of chemical processing and the limited quantities of ashes available for treatment. By means of statistical analyses of the analytical data and geological surveys of the deposits it was possible, moreover, to determine which type of lignite is the most favorable for uranium as well as to advance hypotheses on source and accumulation to explain the occurrence for uranium in Italian lignite deposits. (auth)

207 USE OF ^{206}Pb RADIOGENIC ISOTOPE HALOES IN URANIUM MINERALIZATION PROSPECTING IN ACIDIC VOLCANIC ROCKS. Rossman, G. I.; Sychev, I. V.; Tarkhanova, G. A.; Chesnokov, L. V. Izv. Akad. Nauk SSSR, Ser. Geol.; No. 1, 79-87(Jan 1971). (In Russian).

The use of radiogenic halos from ^{206}Pb in prospecting and evaluating uranium mineralization was examined, specifically when localized in acidic volcanic rocks. Lead-206 halos occur in the range of structures which carry uranium mineralization. A halo is manifest in particular where radiometric anomalies are weakly expressed from the surface of leached-out crustal rocks. A halo of the radiogenic isotope ^{206}Pb, in conjunction with halos of uranium and with total lead, may be used for evaluating possible erosional shearing action of the mineralization, and, for leached-out zones, for forecasting the zones of concentrated uranium in underlying parts of ore-bearing structures. (tr-auth)

208 METHOD FOR DISCRIMINATING BETWEEN BIOGENIC AND CHEMICAL ORIGINS OF THE ORE-STATE PYRITE IN A ROLL-TYPE URANIUM DEPOSIT. Warren, C. G. (Geological Survey, Denver. Colorado State Univ., Fort Collins). Econ. Geol.; 66: No. 6, 919-28(Sep-Oct 1971).

Some roll-type uranium deposits are marginal to an altered tongue in sandstone beds that originally contained more-or-less uniformly distributed pyrite. Mineralizing solutions percolated through the sandstone, oxidized nearly all the pre-existing pyrite, and then redeposited part of the pyrite downstream in an embryonic ore zone. The pyrite and the entire ore zone continued to migrate downstream in the sandstone, much as a sand dune migrates. The amount of pyrite in mature deposits varies systematically with the position in the ore body. It is postulated that the rate at which the pyrite was redeposited controlled the systematic variation in distribution of pyrite. Biogenic and chemical models which are described in the literature provide alternate

explanations for the genesis of roll-type uranium deposits in sandstone. The different theoretical rates for the precipitation of pyrite in the two genetic models provide a distinctive distribution of pyrite that characterizes each process. The theoretical difference between the biogenic and chemical models provides a mathematical technique for identifying the origin of a deposit. Mathematical analysis of the pyrite content of a uranium deposit in the Shirley Basin, Wyoming, illustrates a practical application of the theory. Although a definite conclusion about the origin of roll-type deposits would require considerably more data than are now available, the pyrite content of this deposit does correspond to the theoretical pyrite content of the chemical model, suggesting that a disproportionation reaction was involved in its formation. (auth)

209 SOME OBSERVATIONS ON URANIUM–COPPER RELATIONSHIP IN THE SURDA COPPER MINES AND THEIR BEARING ON THE ZONING OF MINERALIZATION IN THE SINGHBHUM THRUST BELT, BIHAR. Sharma, K. K. (Dept. of Atomic Energy, New Delhi). Proc. Indian Nat. Sci. Acad., Part A; 36: No. 5, 319-30(Sep 1970). (CONF-681088-5).

From Symposium on the geology and mineralogy of atomic mineral deposits and their development for use in the nuclear power program; New Delhi, India (14 Oct 1968).

The uranium and copper lodes in the 5th level of the Surda Mines showed similar spatial distribution and revealed a sympathetic distribution in a selected section. Data from Roam–Rakha and Mosaboni–Badia sections showed a gradual separation of uranium and copper, while Keruadungri–Jaduguda and Kanyaluka–Bhalki sections marked a clear separation of the two. The studies suggest three horizontal zones in the Singhbhum Thrust Belt—a central zone and an intermediate zone which include all the important deposits of copper and an outer zone showing all the uranium deposits known so far. It is further suggested that the focus of mineralization was close to the Surda–Pathargarah area and that migration of fluids laterally on both sides developed a gradual separation of uranium and copper, resulting in the above-mentioned zones of mineralization. No major time gap between the uranium and copper mineralization was conceived. (auth)

Oceanography

Refer also to abstract 188.

210 (BNWL-SA-3993) NUCLEAR TECHNIQUES FOR TRACE ELEMENT AND RADIONUCLIDE MEASUREMENTS IN NATURAL WATERS. Perkins, R. W.; Rancitelli, L. A. (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1971. Contract AT(45-1)-1830. 32p. (CONF-710818-1). Dep. NTIS.

From Meeting on nuclear methods in environmental research; Columbia, Mo. (23 Aug 1971).

Methods for measuring the trace element and radioisotope contents in natural waters and for using these measurements for studying biogeochemical processes in fresh and salt water systems are discussed. (L.C.L.)

211 (WASH-1185) RADIOACTIVITY IN THE MARINE ENVIRONMENT. A Summary Report. Waldichuk, Michael (Fisheries Research Board of Canada, West Vancouver (British Columbia). Pacific Environment Inst.). 1971. 28p.

The state of knowledge on injection, dispersal, uptake by the biota, transfer through the food web, effects on the ecosystem, and ultimate disposition of artificial radionuclides in the marine environment are summarized. Topics covered include: sources of radioactivity and their characteristics; oceanic distributions of radionuclides from nuclear explosions; physical processes of water movement and mixing; marine chemistry; marine sediments and radioactivity; accumulation and redistribution of radionuclides by marine organisms; ecological interactions of marine radioactivity; radiation effects; and evaluation of human radiation exposure. (P.C.H.)

Seismology

Refer also to abstracts 198 and 222.

212 (UCRL-50977) COMPARISON OF CALCULATED AND MEASURED RESPONSE OF A HIGH-RISE BUILDING TO GROUND MOTIONS PRODUCED BY UNDERGROUND NUCLEAR DETONATIONS. Tokarz, Frank J.; Bernreuter, Don L. (California Univ., Livermore. Lawrence Radiation Lab.). 23 Dec 1970. Contract W-7405-eng-48. 34p. Dep. NTIS.

The dynamic response of the Bank of Nevada building in Las Vegas to ground motions resulting from several underground nuclear detonations at the Nevada Test Site was investigated. The events chosen were Handley, Benham, Jorum, and Boxcar. Both a time-dependent analysis, using the modal superposition method, and a spectral response analysis are presented. A brief outline of both methods is included. The ground motion was measured at the base of the building and at NOAA-NOS seismic stations designated as SE6 and Squires Park. Measured time-history records were used as the exciting motion inputs for the analyses. The peak response of the roof of the building was also measured for each event. In addition, for the Handley Event the time-history response was measured at various levels of the building. A comparison was made between the calculated and measured peak responses and between time-history responses. A study was made of the sensitivity of the response calculations to three factors: the mathematical model of the building, the input ground motions, and the value of viscous damping. The results indicate that reasonable modeling assumptions can lead to models whose calculated response is quite different from the measured response; when measured ground motions as near as 800 m from the building are used for the exciting motion, the calculated and measured response values are different; and when a posteriori information of the building (e.g., mode shapes, fundamental periods, and damping) is used, it is possible to develop a model whose calculated response agrees very well with the recorded time-history response of the building. (auth)

213 SEISMIC SOURCE SUMMARY FOR U. S. UNDERGROUND NUCLEAR EXPLOSIONS, 1961–1970. Springer, Donald L.; Kinnaman, Ross L. (Univ. of California, Livermore. Atomic Energy Commission, Las Vegas, Nev.). Bull. Seismol. Soc. Amer.; 61: No. 4, 1073-98(Aug 1971).

A summary of information is presented for all announced US underground nuclear explosions detonated from 1961 to 1971. The data include detonation times, locations, and depths of burial, as well as information about shot media and surface collapse (subsidence) phenomena. This summary is intended to furnish all available source data for studies of seismic sources, as well as studies of seismic transmission characteristics of the Earth. (auth)

214 AMPLITUDE SPECTRA OF SURFACE WAVES FROM SMALL EARTHQUAKES AND UNDERGROUND NUCLEAR EXPLOSIONS. Tsai, Yi-ben; Aki, Keiiti (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 76: No. 17, 3940-52 (10 Jun 1971).

Theoretical amplitude spectra of surface waves in a layered half-space are compared with the observed spectra for 13 underground nuclear explosions in the Nevada Test Site and for 12 earthquakes in the Gulf of California and in the United States. The amplitude spectral shape of Rayleigh waves for periods from 10 to 50 sec from explosions does not vary much with the shot medium and the shot yield. Neither the source time function nor the finite source size appears to be the primary cause of the difference in spectral shape between underground nuclear explosions and small earthquakes. Rather, it is due to the small difference in focal depth and the different depth dependence of spectrum for different source mechanisms. This result gives a theoretical basis for the use of amplitude spectra of Rayleigh waves at long periods as seismic discriminants between underground explosions and earthquakes. (auth)

215 CAUSES OF REGIONAL VARIATION OF MAGNITUDES. Ward, Ronald W.; Toksoez, M. Nafi (Massachusetts Inst. of Tech., Cambridge). Bull. Seismol. Soc. Amer.; 61: No. 3, 649-70(Jun 1971).

Data from the short and long-period seismographs at the Norwegian Seismic Array (NORSAR) were used to investigate the discrimination of earthquakes and underground nuclear explosions using surface-wave versus body-wave magnitude (M_s versus m_b). Earthquakes and explosions occurring within the western United States and recorded in Norway exhibit either anomalously large surface waves or anomalously low compressional body waves compared to events from central Asia. These data, as well as the results of other investigators, indicate an anomaly of 0.8 to 1.0 in M_s or 0.6 to 0.8 in m_b or some linear combination of the two. The mechanism producing anomalously large M_s values from a region for explosions and the cause of lower m_b values are investigated in terms of stress relaxation triggered by an explosion and regional variations in attenuation in the upper mantle beneath both the source region and the receiver region. The method of short-period amplitude spectral ratio is applied to the records of the waves from five deep events to determine the difference in attenuation beneath different receivers. The relative Q model inferred from these data for the upper mantle from 50 to 750 km depth is $Q_{LASA} = 75$, $Q_{TFSO} = 175$,

and $Q_{NORSAR} = 390$. The circum-Pacific island arc exhibits an apparent source attenuation asymmetry. The data from the mid-Atlantic ridge indicate that strong attenuation may be associated with parts of the ridge. The relative difference of the Q model between LASA and NORSAR results in a difference in m_b of 0.40 for distances of 60° to 80°, which agrees well with the observed differences in m_b. It is concluded that regional variations of attenuation in the upper mantle play an important role in regional differences in M_s versus m_b relationship. (auth)

216 EFFECT OF YUCCA FAULT ON SEISMIC WAVE PROPAGATION. Hays, Walter W.; Murphy, John R. (Environmental Research Corp., Las Vegas, Nev.). Contract AT(29-2)-1163. Bull. Seismol. Soc. Amer.; 61: No. 3, 697-706(Jun 1971).

Yucca Fault is a major structural feature of Yucca Flat, a well-known geological province of the Nevada Test Site (NTS). The trace of the Fault extends north–south over a distance of about 32 km. The fault plane is nearly vertical and offsets Quaternary alluvium, Tertiary volcanic tuffs and pre-Cenozoic basement rocks (quartzites, shales and dolomites) with relative down displacement of several hundred feet on the east side of the fault. Data recorded from the CUP underground nuclear detonation in Yucca Flat typify the effect of the fault on near-zone (i.e., inside 10 km) seismic wave propagation. The effect of the fault is frequency dependent. It affects the frequency components (3.0, 5.0, 10.0 Hz) of the seismic waves which have characteristic wavelengths in the order of the geological discontinuity. Little or no effect is observed for low-frequency components (0.5, 1.0 Hz) which have wavelengths exceeding the dimensions of the geological discontinuity. The effect of the fault does not represent a safety problem. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 198, 201, 212, 213, 215, 216, 367, and 981.

217 (BNWL-1614) PLOWSHARE GEOTHERMAL STEAM CHEMISTRY, INTRODUCTORY STUDIES. Charlot, L. A.; Morgan, W. C.; Warner, I. M. (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1971. Contract AT(45-1)-1830. 50p. Dep. NTIS.

A two-month exploratory study of Plowshare-geothermal steam chemistry was completed and the results described. The purpose of the study was a determination of the kinds and concentrations of radioactive and nonradioactive contaminants likely to be brought to the surface by the export steam. An apparatus was constructed for the purpose of contacting with hot water granite samples cored from the region of the Piledriver underground nuclear explosion. Both steam and water phase samples were analyzed for material (elements) leached from the rock. Steam-water distribution rates were calculated for the major radioactive and nonradioactive, leachable species. For radiocesium and antimony, solubilities are sufficiently high in steam as well as water that transport could raise operational problems. Low concentrations of europium, cerium, and ruthenium radionuclides were found for the test conditions: 450 to 650°F, two-phase steam–water environment. Concentrations in the steam were undetectable. These elements should pose no problems to geothermal steam plants. Silica is the principal constituent dissolved from the rock, representing 80% of the water soluble material. Evidence is presented showing that silica significantly affects distribution ratios of the radionuclides of interest. Recommendations for further study of these and related topics are presented. (auth)

218 (BNWL-SA-4079) STATUS OF PLOWSHARE GEOTHERMAL POWER. Stewart, D. H. (Battelle Pacific Northwest Labs., Richland, Wash.). 18 Oct 1971. Contract AT(45-1)-1830. 6p. (CONF-711017-1). Dep. NTIS.

From Meeting on current status of industrial applications of nuclear explosives; Bal Harbour, Fla. (18 Oct 1971).

The status of investigations of using underground nuclear explosions to produce or to simulate the natural production of geothermal power, the economics and feasibility of such applications, and the effects of the U. S. Senate bill, S. 1349, on this program are discussed. (L.C.L.)

219 (LMSC-D-177630(Vol.3)) STUDY OF NUCLEAR EXPLOSION SERVICES FIELDING SYSTEM. VOLUME III. SUPPORTING DATA (APPENDIXES I AND J). Final Report, Phase II. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). 24 Jun 1971. Contract AT(26-1)-526. 30p. Dep. NTIS.

Supporting data for the study of a nuclear explosion services fielding system are presented in two appendixes. The first contains ten field operations personnel support requirements schedules which served as a basis for determining the number, skill levels, and personnel transportation costs needed to satisfy the field operations requirements. The second contains eight transportation schedules which were developed from the 8 Plowshare Program annual schedules, and which served as a basis for determining the cost and quantity of equipment and personnel required to satisfy the explosive transportation function for various operations. (L.C.L.)

220 (NCG-TR-15(Vol.2)(App.)) EMPIRICAL STUDY OF BEHAVIOR OF CLAY SHALE SLOPES. VOLUME 2. APPENDIXES. Fleming, R. W.; Spencer, G. S.; Banks, D. C. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). Dec 1970. 320p. Dep. NTIS.

A study was undertaken to determine the factors that lead to instability in clay shale, and thus to provide a basis for assessing the probable long-term stability of high crater slopes in clay shales. Experimental data for this study are presented in several appendixes which contain the following information: geological data pertinent to clay shale slopes along the Upper Missouri River; borehole data for Upper Missouri River Valley clay shales; laboratory tests of clay shales along the Upper Missouri River; clay shale slope behavior from selected major engineering projects; and survey of clay shale slope behavior from other geographical areas. (L.C.L.)

221 (ORNL-TM-3541) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIONS (CANE): PROGRESS REPORT FOR APRIL 1 TO JUNE 30, 1971. Arnold, W. D.; Crouse, D. J. (Oak Ridge National Lab., Tenn.). 9 Sep 1971. 14p. Dep. NTIS.

Tests simulating the storage of natural gas in a cavity formed with nuclear explosives showed essentially no tritiation of methane when stored in contact with rock salt or Lewis shale that were contaminated with tritiated water. The gas was slightly contaminated with tritiated water vapor. More than 99% of the tritiated water was removed from salt or Lewis shale samples before gas storage by flooding the storage vessel with water and less efficiently by purging the system with air. (auth)

222 (PNE-5013) CRATER STABILITY UNDER THE INFLUENCE OF LARGE SEISMIC MOTIONS. Shackelford, T. J. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). Mar 1971. 36p. Dep. NTIS.

An empirical study of the effects of large seismic motions on crater slopes is reported. Data were obtained from measurements of the effects of the seismic motions generated by the Handley Event on the Cabriolet and Schooner craters. Accelerometers recorded the ground motions; aerial photographs and ground surveys documented the permanent ground displacements. The Handley Event was detonated on Pahute Mesa at the Nevada Test Site approximately 10,000 ft from the Cabriolet crater and 18,000 ft from the Schooner crater. The slopes at Cabriolet were subjected to the estimated peak radial (horizontal) acceleration of 0.74 g; the slopes at Schooner, to 0.36 g. Material displacements at Cabriolet and Schooner craters were confined to the loose surface material and individual boulders. Visible downslope movement occurred in the fallback, and tension cracks appeared in the apparent crater lips, but no adjustments in the true crater were observed. Since no major changes in crater geometry occurred under severe ground acceleration, it appears that crater slopes are likely to remain essentially stable when subjected to large seismic motions. (auth)

223 (UCRL-50993(Rev.1)) PREDICTION OF UNDERGROUND NUCLEAR EXPLOSION EFFECTS IN WAGON WHEEL SANDSTONE. Terhune, Robert W. (California Univ., Livermore. Lawrence Radiation Lab.). 13 Sep 1971. Contract W-7405-eng-48. 26p. Dep. NTIS.

Project Wagon Wheel is a study to investigate the technical concept of nuclear stimulation of a natural gas reservoir located near Pinedale, Wyoming. The results of computer calculations, simulating the explosion effects, based on equation-of-state measurements of core samples taken from EPNG Wagon Wheel No. 1 hole at a depth between 8,000 to 12,000 ft are presented. The shear failure envelope for Wagon Wheel sandstone is almost identical to that for Hoggar granite. A calculation for Wagon Wheel sandstone for one-kt energy at a depth of 300 m duplicated cavity radius, shear fracture radius, stressed region, peak particle velocity, and peak acceleration data measured from the nuclear experiments conducted in the Hoggar granite by the French. The conclusion drawn from this comparison is that the Hoggar granite chimneys and regions of increased permeability provide a reasonable model to assume for Wagon Wheel. A single explosive detonated at a depth of 10,000 ft is predicted to produce a cavity radius of 5.77 $W^{\frac{1}{3}}$ (m, $kt^{\frac{1}{3}}$), with shear fractures extending out to 2.5 cavity radii followed by a stressed region to 5 cavity radii. The expected chimney will have a radius of 1.2 cavity radii and a height of 2.5 cavity radii above the shot point, resulting in an apical void at the top representing about 50% of the cavity volume. Large increase in permeability is expected only within the region of shear fracture. Chimney height for multiple detonations is expected to be 4 cavity radii based on a rubble porosity of 21%. Explosive spacing for multiple simultaneous detonations varies from a minimum of 5 cavity radii (tangent chimneys) to 7.0 cavity radii based on maximum fracture increase due to shock interaction. Explosive spacing for sequential detonation varied between 7.5 and 12.5 cavity radii based on the similarity between cratering phenomenology (reflecting a shock from the ground surface) and reflecting a shock off the apical void of a previously formed chimney. It is expected that a permeable annular ring will form around the axis between the two explosives to connect the lower chimney with the cavity above. (auth)

224 (UCRL-73170) TRITIUM PRODUCTION IN PLOWSHARE APPLICATIONS. Lessler, R. M.; Green, J. B. Jr.; Holzer, F. (California Univ., Livermore. Lawrence Radiation Lab.). 3 Aug 1971. 20p. (CONF-710809-6). Dep. NTIS.

From Tritium symposium; Las Vegas, Nev. (30 Aug 1971).

Production of tritium by Plowshare explosives is the subject of continuing research and evaluation, with reference especially to

the applications now being considered: gas and oil well-stimulation, gas storage, mineral leaching, production of geothermal power, waste disposal, and excavation. About 5,000 to 20,000 Ci/kt of tritium are produced by the fusion reaction, while only about 1 Ci/kt of tritium is produced in the fission process. About 2×10^{23} n/kt escape from both ordinary fission and fusion explosives. Both static and dynamic multienergy neutronic-group Monte Carlo methods were used to calculate the neutrons escaping into the environment and to evaluate the efficiencies of various internal and external shielding materials in absorbing these neutrons. These calculations were also used to study the effects of rock components, especially lithium and boron, and the rock temperature during the time of neutron capture. In a typical gas-bearing medium, from 1 to 3% of the neutrons escaping into the rock will produce tritium. The total residual tritium from the 29-kt Gasbuggy Event was 1400 Ci/kt. Work on reducing this amount has progressed to the point where about 12 Ci/kt were produced in the recently fired 80-kt Miniata Event. (auth)

225 POSLEDSTVIYA VOZMOZHNOGO PRIMENENIYA YADERNOGO ORUZHIYA, A TAKZHEPOSLEDSTIVYA PRIOBRETENIYA I DAL'NEISHEGO RAZVITIYA YADERNOGO ORUZHIYA DLYA BENZOPASNOSTI I EKONOMIKI GOSUDARSTV. (Consequences of the Possible Use of Nuclear Weapons, and Also the Consequences of Acquisition and Further Development of Nuclear Weapons to the Security and Economics of the Governments). Karpov, A. V. (ed.). Moscow; Izdatel'stvo Mezhdunarodnye Otnosheniya (1970). 108p.

This report to the Soviet people by the Presidium of the Academy of Sciences, USSR, was compiled from a 1966 report by UN Secretary-General U Thant. General characteristics of nuclear explosions are discussed, such as initial and residual radiation, effects of a megaton bomb on a given population or on an assortment of variously constructed dwellings, and genetic effects. Basic assembly costs of nuclear warheads are presented for ^{233}U, ^{235}U, or ^{239}Pu and for the agents of delivery such as planes or rockets. Political and economic consequences of the use of nuclear weapons are weighed, with extensive tables of cost data using the U. S. dollar as the monetary unit. (K.S.W.)

226 RESERVOIR AND CANAL CONSTRUCTION USING NUCLEAR EXPLOSIONS. Indian J. Power River Valley Develop.: 20: No. 7, 311-12(Jul 1970).

Extensive studies on industrial uses of nuclear explosions have been carried out both in the USA and USSR. The latter has gone far ahead in terms of practical experimentation. Two types of blasts, contained blasts and excavation blasts were investigated. The former, being less hazardous, was studied in greater detail. Moreover, it is in accordance with the nuclear test ban treaties. Excavation blasts are expected to be more economical than modern mining methods. Projects like uncovering of mineral deposits, canal, dam, and harbor construction, and creation of cuts and embankments have been considered with excavation blasts. Contained blasts are expected to be used for storing natural gas and gas condensates underground, for burial of poisonous industrial wastes, etc. Studies are carried out by simulated explosions under laboratory conditions, by using chemical explosions and by nuclear explosions, both at test ranges and at sites of potential projects. These are of maximum use in building reservoirs in deserts where acute water shortage is experienced. Central and southern regions of the European part of USSR can make use of this for diverting northern rivers, particularly the Pechora River. The cost is expected to be reduced by a factor of 3 to 3.5. Such experiments, however, can be conducted only in sparsely populated regions and hence impossible in India, where such desert lands are not available. (INIS)

227 VARIATION OF NUCLEAR EXPLOSION GENERATED ACOUSTIC-GRAVITY WAVE FORMS WITH BURST HEIGHT AND WITH ENERGY YIELD. Pierce, Allan D. (Massachusetts Inst. of Tech., Cambridge); Posey, Joe W.; Iliff, Elisabeth F. J. Geophys. Res.; 76: No. 21, 5025-42(20 Jul 1971).

A formulation of a method for synthesizing theoretical infrasonic far-field pressure wave forms generated by nuclear explosions is described which differs from that described by Harkrider in 1964 primarily in the method by which the source presence is incorporated. The rationale of the model is described and a number of predicted wave forms created by the detonation of nuclear explosions in temperature-stratified and wind-stratified atmospheres are presented to illustrate the effects of winds and the effect of the varying energy yield and of the height of burst. Theoretical wave forms are compared with a number of observed wave forms previously exhibited by Harkrider. Discrepancies are pointed out among the predictions of Scorer, of Weston, of Hunt, Palmer, and Penney, and of Harkrider as to the effects of height of burst. Our formulation predicts the early portion of wave forms received on the ground to be nearly proportional to yield and to increase slowly with height of burst up to a height of the order of 40 km (which depends on yield) and then to decrease rapidly with further increasing height. These predictions are explained in simpler terms if the early portion of the wave form is assumed to be carried in a single composite guided mode analogous to that predicted by Lamb for the isothermal atmosphere. (auth)

228 CRUSHING OIL SHALE WITH NUCLEAR EXPLOSIVES. Parker, Harry W. (to Phillips Petroleum Co.). U. S. Patent 3,593,788. 20 Jul 1971. Filed 5 Sep 1967.

The effectiveness of nuclear explosions in an oil shale stratum to create a mass of shale rubble, suitable for in situ retorting, is increased by hydraulically fracturing prior to the explosion a portion of the stratum above the level of the stratum which will be shattered by the explosion. (Official Gazette)

Facilities and Equipment

Refer also to abstracts 449, 486, 747, 798, 810, and 1112.

229 (BLG-452) EXPERIMENTAL SETUP FOR CARRYING OUT LOW TEMPERATURE ALPHA RADIATION. von Heydon, G. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Feb 1971. 26p. (In German). Dep. NTIS (U. S. Sales Only).

An experimental setup is described in which the production of defects in thin metal foils by irradiation with alpha particles at temperatures down to 2.5°K and their subsequent recovery up to 100°K can be studied by means of electric-resistivity measurements. Following the low-temperature irradiation, it is possible to perform exact measurements of the critical temperature T_c of superconductivity and residual resistivity measurements without warming up the specimens. (auth)

230 (ORNL-TM-3393) CONTROLLED-TREND PARAMETER VARIATION TESTS ON THE OSW WRIGHTSVILLE BEACH THREE-STAGE FLASH EVAPORATOR, AUGUST 1970. Ball, S. J.; Clapp, N. E. Jr.; Delene, J. G. (Oak Ridge National Lab., Tenn.). Nov 1971. Contract W-7405-eng-26. 58p. Dep. NTIS.

A series of tests was run on a three-stage experimental flash evaporator at the Office of Saline Water Test Station at Wrightsville Beach, North Carolina in August 1970. The purpose of these tests was to determine correlations to be used in dynamics and control studies of future large-scale multistage flash (MSF) desalting plants connected to nuclear-reactor heat sources. Results from controlled-trend tests to study nonequilibrium losses and interstage orifice brine flow behavior were analyzed and correlations were determined. This trend test method greatly enhanced the output rate of useful information. With special consideration given to measurement and data-acquisition problems, internally consistent and reproducible results were obtained. The combined effects of nonequilibrium loss and hydraulic behavior on stage and overall plant stability and operability were studied. The resulting data and correlations were compared with the currently used design correlation, and recommendations were derived for future tests. (auth)

231 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. (to Stal-Laval Apparat Aktiebolag). British Patent 1,245,918. 15 Sep 1971. Priority date 1 Apr 1969, Sweden.

A heat exchanger, designed with means for cooling the casing, is described. Besides the tubes which carry the heating medium, a screen around the tubes is provided, and the heating medium operates a jet pump which pumps the heated medium from the narrow space between the screen and the upper casing into the lower portion of the casing. The screen is designed so that the medium arriving in the narrow space comes from the cold zone. In this way, the temperature can be held at a level which will not cause deformation of the casing. (D.L.C.)

232 PROTECTION EQUIPMENT FOR A PNEUMATICALLY CONTROLLED IRRADIATION DEVICE. (to Etablissements Lemer et Cie, SA). French Patent 2,036,119. 14 Dec 1970. Filed 4 Mar 1969. (In French).

A device is described which assures the return of a radioactive source to the interior of its biological protection in the event of damage to the equipment moving the source. The device consists of a piston carrying the source and a cylinder in which the piston moves under the action of compressed air. (France)

233 PIPING SYSTEMS. HPAC Conference Proceedings, Chicago, November 3-5, 1969. Chicago; Reinhold Publishing Corporation (1970). 159p. $3.50. (CONF-691134).

Twenty-one papers on piping systems for chemical and petrochemical processing plants and for conventional and nuclear power plants were presented at the conference and are included in the proceedings. A separate abstract was prepared for each of 4. Seventeen papers were not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 234, 235, 287, and 471.

234 CLEANING OF PIPING FOR NUCLEAR SYSTEMS. Stock, Hugh J. (General Electric Co., San Jose, Calif.). pp 108-12 of Piping Systems. Chicago; Reinhold Publishing Corp. (1970).

From HPAC conference on piping systems; Chicago, Ill. (3 Nov 1969). See CONF-691134.

The cleaning of piping for nuclear plants is discussed as to objective, methods, damage prevention during cleaning, effects of cleaning residuals, methods for specifying cleaning procedures, and the protection of cleaned pipes during shipment and storage. (L.C.L.)

235 HOW NUCLEAR PIPING CODE RULES WILL INFLUENCE PIPING DESIGN: TODAY AND TOMORROW. pp 145-59 of Piping Systems. Chicago; Reinhold Publishing Corp. (1970).

From HPAC conference on piping systems; Chicago, Ill. (3 Nov 1969). See CONF-691134.

A panel discussion of the development of the Nuclear Piping Code ANSI B31.7 and of the significance of this code to the design of, materials selection for, and operation of nuclear plant piping systems is presented. (L.C.L.)

236 IRRADIATION EQUIPMENT IN THE FRENCH RESEARCH REACTORS. Bull. Inform. Sci. Tech. (Paris; No. 153-154, 49-54(Nov-Dec 1970). (In French).

One of the main reasons for the development of irradiation devices throughout the world, and particularly in France, is associated with the study of different types of reactors. The principal types of irradiation devices developed by the CEA are described: capsules, loops and materials associated with in pile experiments (devices for moving loops and capsules during irradiation, cold or hot neutron sources, neutron radiography equipment). The loops and capsules must present an acceptable neutron absorption and be resistant to corrosion and radiation. Thermal effects and safety problems associated with γ radiation are considered. (France)

237 BINS AND BUNKERS FOR HANDLING BULK MATERIALS. PRACTICAL DESIGN AND TECHNIQUES. Reisner, Wolfgang; von Eisenhart Rothe, Michael. Series on Rock and Soil Mechanics, Volume 1 (1971) No. 1. Cleveland; Trans Tech Publications (1971). 296p. $20.00.

Partly translated from German.

The theoretical and practical aspects of handling and storing bulk materials such as grain, mineral products, sand and gravel, chemicals, nuclear materials, etc., in bins, bunker, and silos were surveyed. Details are presented on gravity flow, major design criteria, loads, shape, and bin activation methods. All important publications in worldwide literature on bin and bunker technology were evaluated. A 333 item bibliography with English titles is presented. A list of 61 equipment manufacturers in several countries is included. (L.C.L.)

238 ACTIVITIES AT NERATOOM. De Boer, G. A. Nucl. Eng. Int.; 16: 409-12(May 1971).

The development of major sodium components for the SNR project is discussed. The construction of a 5000 m^3/hr prototype pump is described. The Na–Na heat exchanger is designed with vertical straight tubes and a floating head. A special cover enables defective tubes to be plugged. Welds, made by a specially developed internal bore welding procedure, are inspected by a small focus x-ray apparatus. In the present design of the steam generator, straight tubes are applied without welds to avoid leakage. Expansion differences between shell and tube bundles are absorbed in a bellows. Testing of prototypes of evaporator and superheater is briefly described. Work is proceeding on an alternative steam generator design. (UK)

239 AIR CONDITIONING IN RADIOACTIVE INSTALLATIONS. ATOMIC POWER STATION. Kasagi, Toru (Shin Nippon Air Conditioning Co. Ltd., Tokyo). Reito; 44: No. 505, 1084-93(Nov 1969). (In Japanese).

Many atomic power stations are being built in Japan by utility companies. Although reactor plants have so far been imported, those produced by domestic technology are forthcoming. In this connection, the air conditioning facilities in such power stations deserve special attention. Air conditioning in atomic power stations is described, using the Fukushima Atomic Power Station as an example. The power station buildings, including those for reactor, turbine, servicing, central control, and radioactive wastes handling are described. The air conditioning of these buildings, air conditioning facilities for the atomic power station, the utilization of atmospheric air, devices and instruments, the cooling of a dry well, central control room in an emergency, emergency gas-systems, and the technological criteria air conditioning an atomic power station are discussed. (Japan)

240 STRESS ARRANGEMENT IN PCPV BY PRESTRESSING TENDONS IN A NUCLEAR POWER STATION. Ujiie, Koji; Takase, Hiromoto; Murata, Toyomi; Masuda, Kiyoshi (Kajima Construction Co. Ltd., Tokyo). Kajima Kensetsu Gijutsu Kenkyusho Nempo; 18: 393-8(Oct 1970). (In Japanese).

In an elementary model of prestressed concrete pressure vessel (PCPV), there were prestressed tendons arranged in a radial direction in the upper circular plate, a circumferential direction in the cylinder, and in a generatrix direction in the cylinder. Analysis of the PCPV model with application of prestress force through tendons is discussed along with a stress arranging method in which the amount of total prestress of tendons can be determined. Under such prestress of tendons, stresses on every part of the PCPV model will not exceed the allowable stress of concrete. Regarding stress analysis of the PCPV model due to prestress forces, three cases were analyzed independently to be able to superimpose the results of analysis afterwards. It was found that: with prestress in radial direction, stress distribution is limited to a part of the upper circular plate and these stresses tend to decrease the inner pressure stresses. With prestress in circumferential direction, compressive stresses decrease the stresses due to inner pressure and heat. With prestress in generatrix direction, almost equal compressive stresses can be found over the entire cylinder which decrease the stresses due to inner pressure. A formula is included by which the amount of tendon prestress in each direction can be determined. (auth) (Japan)

241 STRESS ANALYSIS OF PCPV RESULTING FROM INNER PRESSURE IN A NUCLEAR POWER STATION. Ujiie, Koji; Takase, Hiromoto; Murata, Toyomi; Masuda, Kiyoshi (Kajima Construction Co. Ltd., Tokyo). Kajima Kensetsu Gijutsu Kenkyusho Nempo; 18: 379-84(Oct 1970). (In Japanese).

The internal pressure is considered to be the most fundamental design load applied to (PCPV) prestressed concrete pressure vessels. The theory of stress analysis as applied to inner vessel pressure is analyzed and an example is given. The finite element method (FEM) which is an extension of the plane strain FEM to an axisymmetric problem was used in the analysis. For an example, a cylinder was used as an elementary model of PCPV. The dimensions of the cylinder were height 40 m, inner diameter 10 m, and outer diameter 20 m. The depth of the upper and lower circular plates were 4 m and 6 m, respectively. Inner pressure of 100 kg/cm^2 was applied to the inner face of the model. Results of this analysis are as follows: Maximum displacement of about 0.5 cm, at the middle part of the cylinder, and maximum tensile stress of 190 kg/cm^2, at the conjunction part between the cylinder and the upper circular plate. (auth) (Japan)

242 THERMAL STRESS ANALYSIS OF PCPV RESULTING FROM INNER HEAT IN A NUCLEAR POWER STATION. Ujiie, Koji; Takase, Hiromoto; Murata, Toyomi; Masuda, Kiyoshi (Kajima Construction Co. Ltd., Tokyo). Kajima Kensetsu Gijutsu Kenkyusho Nempo; 18: 385-92(Oct 1970). (In Japanese).

The theory of thermal stress analysis resulting from inner heat (radiation and conduction) is demonstrated, and an example analysis based on this theory is given. The inner heat is also considered to be fundamental to the design of prestressed concrete pressure vessel (PCPV). This analysis was performed in two steps. The first step was to analyze the temperature distribution of PCPV due to inner heat. The finite element method (FEM) was used in the stress analysis. In this case, however it was necessary to take into account the relationship between the dynamics determined in the inner pressure analysis, and the thermal dynamics under examination. The second step was to analyze the thermal stresses of PCPV resulting from the given temperature distribution. The theory exployed was the same as for the FEM stress analysis reported previously. The result was a formulation of the point forces which correspond to the stresses restraining thermal strains. For an example, the same model used in the previous experiment was adopted. Regarding radiation heat, it was proved that such heat has little influence on PCPV in terms of temperature and stress. Therefore, only the problem of heat conduction was considered. As the condition for analysis, a temperature of 50°C at the inner face and 0°C as the outside air temperature was assumed. As a result of

this analysis, stresses in a coupled form were found on every part of the PCPV model; that is, vertically there were compressive stresses on the inner face and tensile stresses on the outer face; circumferentially the reverse was observed. (auth) (Japan)

243 PRESSURIZED WATER IRRADIATION LOOP IRENE. Bull. Inform. Sci. Tech. (Paris); No. 153-154, 137-9(Nov-Dec 1970). (In French).

The Irene loop is intended for irradiations of small assemblies of fuel pencils in Osiris. The loop will allow tests to be made in the same conditions as in light or heavy water reactors. It consists of an in-pile device and a part outside the pile. (France)

244 THERMAL CONTROL DEVICE USING A LAYER OF GAS FOR COLIBRI. Bull. Inform. Sci. Tech. (Paris); No. 153-154, 83-7(Nov-Dec 1970). (In French).

The Colibri devices were designed in order to irradiate structure and cladding materials or fuel elements between 200 and 800°C. Many types of devices were used in the Osiris and Triton cores. The Colibri device consists of two stainless steel containers, one contained in the other, separated by a layer of gas whose conductivity can be varied during irradiation by altering its helium and nitrogen composition. The observed temperature gradient was reduced to 10°C by additional heating elements thermally controlled to within ±2°C. (France)

245 THERMOPUMP SODIUM CIRCUIT. Bull. Inform. Sci. Tech. (Paris); No. 153-154, 130-1(Nov-Dec 1970). (In French).

The thermopump sodium circuit was designed to irradiate fuel elements in research reactors under thermal conditions identical to those met in fast power reactors. Two devices are placed in the same part of the reactor. The safety of the circuit operation is examined. (France)

246 LIQUID SODIUM LOOP BANJO. Bull. Inform. Sci. Tech. (Paris); No. 153-154, 132-6(Nov-Dec 1970). (In French).

The Banjo loop was placed in the Osiris pool, in the periphery of the core in a zone of very high thermal neutron flux. A circuit for the detection and measurement of fission products and a neutronography device were developed. The loop is described; it consists of the pump, exchanger, rate meter, fuel pin, and reduction vessel with its gas covering. The uses of the loop and the results obtained are investigated. (France)

247 VESSEL PACKING ARTICLE. Kerze, Frank Jr. (to United States Atomic Energy Commission). U. S. Patent 3,567,192. 2 Mar 1971. Filed 13 Jun 1968.

The design of shapes for use in packed beds applicable in reactor fuel production or mass transfer operations involving corrosive atmospheres is described. (J.R.D.)

248 DOORS LOADED WITH HEAVY CONGLOMERATED ORE OR OTHER MATERIALS FOR PROTECTION AGAINST RADIATION. Martin, Andre (to Societe Protix). French Patent 2,036,913. 31 Dec 1970. Filed 15 Apr 1969. (In French).

Instead of using lead to construct radiation protection doors, a mixture of ores or heavy materials such as barium or steel shot, amalgamated by polyester resins, cement or plaster, is used. This malleable mixture is cast into the framework of the door. Hardening takes place through polymerization or drying. (France)

249 SHUT-OFF VALVE FOR HYDRAULIC SYSTEMS. Yalovega, Nilolai Vasilievich (to Moskovsky Ordena Lenina Aviatsionny Institut Imeni Sergo Ordzhonikidze). British Patent 1,232,964. 26 May 1971. Filed 9 Jan 1969.

Reference is made to shutoff valves for hydraulic systems that are suitable to operate with high-temperature corrosive media, such as may be met within nuclear power plants and elsewhere. The object of the system described is to eliminate or reduce the disadvantages of valves commonly used. The valve described is simple and of small size and is claimed to retain its stiffness and shape under high temperature and corrosive conditions, and to afford a considerable shutoff force. The closing member is actuated by a chamber having resilient smooth walls and oval cross-section, fillable with a suitable working medium; the pliable chamber has a curved surface that actuates the closing member, and its walls are preferably constructed of a Nb-based high-temperature alloy, in several layers. The closing member may be required to be secured to the walls of the pliable chamber. In a two-way version of the shutoff valve it is preferable to employ two pliable chambers with individual working systems. For the automatic control of the system it is desirable to install at least one transmitter to indicate the position of the walls of the flexible chamber. (UK)

250 IMPROVEMENTS TO THE ELECTROMAGNETIC PUMPS USED FOR LIQUID METALS. Carbonnel, Henri; Le Frere, Jean (to Groupement Atomique Alsacienne Atlantique). French Patent 2,052,105. 29 Mar 1971. Filed 16 Jul 1969. (In French).

Improvements to an electromagnetic pump for liquid metals described in the leading patent are presented. The device is equipped with a circular pipe; improvements permit an easy disassembling of the system and a very quick access to the pipe and to the magnetic circuits. These circuits are arranged symmetrically around the axis of the pipe. The magnetic coils may be disassembled by moving them in a direction parallel to the axis of the pipe. The core of the magnetic circuits is made of one part or of a number of independent parts equal to the number of coils. (France)

251 FLUIDICS, BASIC PRINCIPLES, AND APPLICATIONS IN NUCLEAR ENGINEERING. Stelzer, F. (Kernforschungsanlage, Juelich, Ger.). Kerntech. Atomprax.; 13: No. 7-8, 339-45 (Jul-Aug 1971). (In German and English).

Fluidics is the branch of engineering concerned with the use of the energy of fluid flows for measuring, logic, and control functions. Fluidic circuits can be used to a large extent similar to electronic circuits, with fluidic elements performing functions similar to those of electronic tubes and transistors. In contrast to most electric elements, however, fluidic elements are insensitive to ionizing radiation and high temperatures, and are therefore increasingly used in nuclear engineering, e.g., for the pickup and processing of signals in reactor experiment facilities. Applications in nuclear engineering are reviewed. (auth

252 IRRADIATION FACILITIES FOR CLADDING AND STRUCTURAL MATERIALS. Kramer, W. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntech. Atomprax.; 13: No. 7-8, 331-8(Jul-Aug 1971). (In German and English).

The selection and development of suitable materials for reactor core structures and, in particular, for cladding tubes of fuel elements play a more and more important role with increasing specific powers. The investigation of the properties of these materials in the radiation field of a reactor requires comprehensive and sophisticated irradiation experiments which can be performed only with special equipment. A brief account of the different types of irradiation facilities is given. The general aspects to be considered in the technical design of such facilities are discussed. The trends apparent in the design of irradiation facilities are briefly outlined. (auth)

253 LARGE DIAMETER VALVE FOR LIQUID METALS UNDER PRESSURE AND AT HIGH TEMPERATURES. Palomo, Georges (to Groupement Atomique Alsacienne Atlantique). French Patent 2,053,455. 5 Apr 1971. Filed 4 Jul 1969. (In French).

A large diameter valve usable with liquid metals under pressure, Na for example, is presented. The temperature of the melting metal may be of several hundreds degrees. The valve has advantages such as a very short time of closure, a perfect tightness, and a long lifetime. (France)

Heat Transfer and Fluid Flow

Refer also to abstracts 242, 244, and 262.

254 (ANL-7842) THEORETICAL STUDY OF TRANSIENT SODIUM BOILING IN REACTOR COOLANT CHANNELS UTILIZING A COMPRESSIBLE FLOW MODEL. Siegmann, Eric R. (Argonne National Lab., Ill.). Jul 1971. Contract W-31-109-eng-38. 167p. Dep. NTIS.

Thesis. Submitted to Northwestern Univ., Evanston, Ill.

The behavior of sodium during boiling and expulsion is an important consideration in the safety of a liquid-metal-cooled fast breeder reactor. A single coolant channel was analyzed to obtain a detailed description of the sodium-coolant density (vapor void fraction) in space and time during flow or power transients that lead to coolant boiling. In the model used, three complete, coupled conservation equations were solved simultaneously with equations for the single-phase region of the coolant and for heat transfer of the fuel element. The model predicts the time-dependent voiding of the sodium coolant starting from steady-state conditions with subcooled liquid. This model was developed to analyze power-transient and loss-of-flow accidents. Power transients were simulated by exponentially increasing the fuel power density. Loss-of-flow accidents were simulated by exponentially decreasing the pressure in the lower plenum. Transients in an oxide-fueled, fast-breeder-reactor coolant channel were analyzed using a Fortran computer program. The results show that after boiling starts

the boiling propagates upstream quickly, although pressure effects on the saturation temperature tends to suppress the growth of the two-phase region; the mass flow rate at the channel entrance decreases very rapidly; and pressures encountered in all problems were not excessively high. The results of this model were compared with the results of a simpler momentum-integral model. The comparison showed that the momentum-integral model overestimates the voiding rate at the start of the transient, but underestimates it later. In general, however, the agreement between the two models was good for the cases compared. (auth)

255 (CISE-R-184) HEAT TRANSFER DATA IN THE LIQUID DEFICIENT REGION FOR STEAM-WATER MIXTURES AT 70 kg/cm² FLOWING IN TUBULAR AND ANNULAR CONDUITS. Topical Report No. 11. Era, A.; Gaspari, G. P.; Hassid, A.; Milani, A.; Zavattarelli, R. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jun 1966. 104p. Dep. NTIS (U. S. Sales Only).

The experimental data obtained at CISE on heat transfer in the liquid-deficient region with vertical upward flow of steam–water mixtures are presented. The experiments were carried out for the following geometric conditions. Circular conduit (D = 0.6 cm; L = 480 cm); annulus (D_r = 1.5 cm; D_t = 1.7 cm; L = 320 cm); and annulus (D_r = 1.0 cm; D_t = 1.5 cm; L = 80 and 120 cm). The flow conditions were: specific mass flowrate of 110 + 380 g/cm²/sec; inlet steam quality (by weight) of from −0.3 (subcooling 70 + 80°C) to +0.80; and pressure of 71 kg/cm² abs. About 2500 heat transfer measurements were carried out in a large variety of conditions. A large number of heat transfer crises data and a few pressure drop data are also reported. A description is given of the experimental plant, the test element characteristics, and the results. A detailed analysis of the data will be presented in a separate report. (auth)

256 (LIB/Trans-381) MODELING OF TWO-PHASE FLOW WITH HEAT TRANSFER. Boure, J. A. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Translated by D. Miles (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from 4th International Heat Transfer Conference, Versailles, France, August 31–September 5, 1970. 13p. Dep. NTIS (U. S. Sales Only).

An abstract of this article, prepared from the original, appeared as NSA 25: 6464(1971). (Australia)

257 (TID-25831) INITIAL EXPERIMENTS TO INVESTIGATE CONDENSATION OF FLOWING METAL-VAPOR/HEATED-GAS MIXTURES IN A DUCT. Bauer, Harold E. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1971. 44p. (K-910900-9). Dep. NTIS.

Research on the flow conditions and injection methods required to rapidly cool metal vapor/gas mixtures in the exhaust duct of a reference engine or in-reactor test unit is reported. The work involved performing limited theoretical investigations and exploratory tests from which qualitative information was obtained on the condensation of a metal-vapor/gas mixture in a flowing stream, while minimizing the deposition of condensed material on the surrounding duct walls. The results of these exploratory tests indicate the need for additional experiments in which measurements of particle size, amount of wall coating, velocity distributions, and temperature distributions within the duct and at the duct wall are made. These experiments should concentrate on the zinc/argon system or other metal-vapor/gas systems, rather than on the iodine/air system because the operating conditions of such tests would more closely simulate the heat transfer and condensation processes in nuclear light bulb reactor exhaust ducts. (auth)

258 COMPARISON OF CRITICAL CAVITATION INCEPTION CONDITIONS IN A VENTURI TUBE WITH WATER AND SODIUM. Bonnin, J.; Bonnafoux, R.; Gicquel, J. (Electricite de France, Paris). Bull. Dir. Etud. Rech., Ser. A; No. 1, 5-12(1971). (In French).

Tests are described in which incipient cavitation conditions in a Venturi tube were compared for cold water and liquid sodium at temperatures ranging between 150 and 450°C. The respective Reynolds numbers coincided over a very wide range. Satisfactory agreement was obtained between the results with both liquids. (France)

259 TRANSIENT METHOD FOR MEASUREMENT OF LOCAL HEAT-TRANSFER COEFFICIENT ON EXTENDED HEATED SURFACES. Oka, S.; Kostic, Z.; Pisiar, V.; Djordjevic, R. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Bull. Boris Kidric Inst. Nucl. Sci., Nucl. Eng.; 21: No. 2, 11-19(Jun 1970).

It is noted that the main failure of the existing methods for determining local heat flux on extended surfaces is the impossibility of estimating the heat losses from the measuring device. A transient method for measuring the local heat flux is suggested which is free from this disadvantage. The theoretical basis of the method and the measuring element design are given. Difficulties in setting-up the measurements and possible errors are discussed. Tests showed the very high accuracy of the method. (auth)

260 EDDY DIFFUSIVITY OF MASS MEASUREMENTS FOR AIR IN CIRCULAR DUCT. Sheriff, N.; O'Kane, D. J. (United Kingdom Atomic Energy Authority, Risley, Eng.). Int. J. Heat Mass Transfer; 14: 697-707(May 1971).

Continuous injection of a tracer gas (nitrous oxide) on the centreline of a circular duct was used to measure the eddy diffusivity of mass for turbulent air flow. Using axial concentration distributions the limitations of the "point source" solution were revealed, and a modified evaluation procedure was adopted. For the Reynolds number range tested, $1.3 \times 10^4 - 1.3 \times 10^5$, the eddy diffusivity of mass, $^6M\alpha$, in the central region of the tube was found to be given by: $^6M\alpha/\nu = 25.27\ Re \cdot 10^{-4} - 3.82$ (ν = fluid kinematic viscosity). Using eddy diffusivities of momentum from previous studies, the turbulent Schmidt number varied between 0.7 and 1.0. (auth) (UK)

261 RADIATION EFFECTS ON SUPERHEATING OF LIQUID SODIUM. Deitrich, L. W. (Argonne National Lab., Ill.). Nucl. Sci. Eng.; 45: No. 2, 218-21(Aug 1971).

The problem of radioinduced nucleation of bubbles in homogeneous liquid sodium is considered with the objective of predicting a nucleation threshold in terms of system temperature and superheat. Nucleation of bubbles on a solid surface was not considered. The analysis was based on the thermal-spike theory of nucleation. It was concluded that radioinduced nucleation will be an effective mechanism for limiting the superheating of liquid sodium to values less than 100 to 250°C, depending on the system pressure, even when the minimum threshold prediction, based on quasi-static bubble formation and fission fragment energy deposition, is used. Changes in the assumptions used to calculate the required nucleation energy, such as addition of the dynamic component, would result in thresholds at much higher temperatures and superheats. (P.C.H.)

Isotope Technology

Refer also to abstracts 232 and 306.

262 (CEA-R-4185) THERMAL COUNTERCURRENTS IN CENTRIFUGES. Soubbaramayer (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1971. 15p. (In French). Dep. NTIS (U. S. Sales Only).

A linear theory is assumed for the thermal countercurrents in a gas centrifuge. Some approximations about the viscous forces are made, and it is shown that the problem reduces to that of searching for the eigenvalues and eigenfunctions of a fourth order linear differential operator. Calculations indicate that zero axial velocity occurs at 87% of the radius. It is also shown that the efficiency K is 85%. (France)

263 (MLM-1853) METALLOGRAPHIC INVESTIGATION OF TWO LARGE RADIOISOTOPIC HEAT SOURCE (LRHS) CAPSULES. Selle, J. E.; Breakall, K. L. (Mound Lab., Miamisburg, Ohio). 29 Sep 1971. Contract AT-33-1-GEN-53. 43p. Dep. NTIS.

Two unvented, 200-W Large Radioisotopic Heat Source (LRHS) capsules were removed from shelf tests in July 1970 for a complete metallographic analysis One capsule was fueled with plasma-fired microspheres and the other capsule was fueled with a PuO_2 microsphere-molybdenum cermet. Examination of the capsules showed that 81.3% of the helium had been released by the fuel; some swelling of the cermet fuel had taken place; and the T-111 strength member of the microsphere-fueled capsule was found to be cracked upon removal from the clad. Furthermore, the Ta–10% W liner in the microsphere-fueled capsule had not only undergone considerable grain boundary oxidation but had also reacted with the impurities present in the fuel. The Ta–10% W liner and T-111 strength member from the Mo-cermet-fueled capsule were not embrittled. (auth)

264 (N-71-25780) CWO NO. 6, RTG USER ACTIVITIES IN AEROSPACE NUCLEAR SAFETY AND OPERATIONS: AN INTERIM RESOURCE ESTIMATE. (Hittman Associates, Inc., Columbia, Md.). 7 May 1971. 58p. (NASA-CR-118633; HA-3908-6-2). NTIS.

The efforts which the radioisotope thermoelectric generator (RTG) user will have to perform as part of an outer planets space-

craft program are described. Six major areas of work are identified including safety documentation support requirements, launch approval request, design support activities, on-lab and launch site operations, emergency procedures manual, and the user's safety analysis report. In each work area a general description of user requirements is presented. The descriptions are one step removed from the point where manpower allocations can be assigned. Each of the six areas of work is broken down to identify those aspects of the task which relate to nuclear safety and those which reflect the category of operations. (auth) (STAR)

265 (SC-RR-710533) THERMAL DESIGN AND ANALYSIS OF THE APOLLO LUNAR RADIOISOTOPIC HEATER. Klett, Robert D. (Sandia Labs., Albuquerque, N. Mex.). Sep 1971. 54p. Dep. NTIS.

The reentry thermal analysis of the Apollo Lunar Radioisotopic Heater for a random tumbling and spinning motion with a surface averaged heat flux is reported. Orbital decay and lunar returns with reentry angles ranging from $-6.25°$ to $-90°$ were analyzed. The temperatures of the heater in a launch pad abort fire were also predicted. The study of the original design led to several recommendations for modifications which were incorporated in the final heater configuration. (auth)

266 (SNC-3693-2) THULIUM OXIDE FOR THERMAL SOURCE APPLICATIONS. PART I. MATERIALS PROPERTIES MEASUREMENTS. PART II. ENVIRONMENTAL BEHAVIOR AND MECHANICAL, THERMAL, AND CHEMICAL STABILITY ENHANCEMENT. Nelson, C. A.; Anderson, R. W.; Fink, C. R.; Tse, A.; Fretague, W. J. (Sanders Nuclear Corp., Nashua, N. H.). 1970. Contract AT(40-1)-3693. 248p. Dep. NTIS.

The feasibility of encapsulated thulium-170 oxide for use as an isotopic fuel was studied. This radioisotope provides a readily produced thermal energy source for operation at temperatures through 1500°C for missions through 180 days. The scope of the work included phase diagram determination, compatibility, capsule parametric design, and radiation shielding. The results show conclusively that thulium-170 sesquioxide can be successfully applied as an encapsulated isotopic fuel. A basic Savannah River Laboratory procedure for preparing Tm_2O_3/Yb_2O_3 composites was experimentally evaluated and a modified procedure used to prepare test coupons. Melting points and solid-state transformations to the melting point of a composition series 100% $Tm_2O_3-Yb_2O_3$ were determined. 100% Tm_2O_3 was observed to melt at 2301 ± 33.5°C and 100% Yb_2O_3 at 2328 ± 33.5°C. The $Tm_2O_3-Yb_2O_3$ system remains cubic to the melting point and is typical of a solid solution system. Solid-state reaction of candidate containment materials (Hastelloy X, Hastelloy C-276, Haynes-25, T-111, TZM, tungsten, and zirconium) with Tm_2O_3/Yb_2O_3 were studied. Containment for times to 10,000 hours at 1600 and to 500 hours at 2000°C were demonstrated; no effects due to Yb_2O_3 addition were observed. The stability of the fuel form as a function of its environment was studied. 100% Tm_2O_3, 80% Tm_2O_3/20% Yb_2O_3, and 100% Yb_2O_3 wafers were subjected to the air, dynamic vacuum and static vacuum at temperatures to 2000°C for times to 100 hours. Results of these experiments showed the Tm_2O_3/Yb_2O_3 cubic structure to be unaffected by elemental levels of iron, aluminum, magnesium and, silicon and unaffected by the environmental conditions imposed on the wafers. Enhancement of the oxide properties was sought through process variable optimization and the addition of metal oxides to Tm_2O_3. Process variables studied were chemical processing of as received Tm_2O_3, calcining temperature, cold pressing pressure, sintering time/temperature/atmosphere, and aging. Properties assessed were physical appearance, microstructure, crystalline structure, grain size, lattice parameter, density, and chemical purity as they are related to fines generation upon impact. Results showed the properties of Tm_2O_3 to be primarily sensitive to sintering temperature. 1750°C was selected as the optimum sintering temperature/time. Enhancement of resistance to fines generation was indicated in post-aged samples. Three metal oxide additives CaO, TiO_2, and Al_2O_3 were studied with the objective of forming a grain boundary precipitate to control fines generation. The presence of 1% additive was inadequate to depress the melting point of Tm_2O_3 or to change the cubic crystalline structure of Tm_2O_3/Yb_2O_3. Tm_2O_3/Yb_2O_3 wafers containing CaO developed a grain boundary phase that improved the resistance to fines generation. The presence of Yb_2O_3 did not appear to measurably influence behavior. (auth)

267 NOVEL ASPECTS AND METHODS OF ISOTOPE APPLICATIONS IN INDUSTRY OF HUNGARY. Foeldiak, G. (MTA Izotop Intezete, Budapest). Izotoptechnika; 14: No. 3, 13-24(Mar 1971). (In Hungarian).

In high capacity, continuous, and automatic plants, the integral circuit nuclear instruments proved to be highly reliable. In many fields of application, computers are also at work. The present management system of the national economy makes the special industrial branch programs the most effective organizational form of isotope applications in Hungary. (auth)

268 FRANCE'S PLANS FOR GASEOUS CENTRIFUGATION. Com. Naz. Energ. Nucl., Notiz.; 17: No. 5, 65-8(May 1971). (In Italian).

A brief discussion of the reasons that have led France to decide to design a European-sized gaseous-centrifugation uranium enrichment plant, and some data concerning the conditions that such plant should meet to prove economically and technically satisfactory. (auth)

269 STANDARDIZATION OF ^{109}Cd SOURCES FOR γ-RAY EMISSION RATE. Hutchinson, J. M. R.; Garfinkel, S. B. (National Bureau of Standards, Washington, D. C.). Int. J. Appl. Radiat. Isotop.; 22: No. 7, 405-14(Jul 1971).

The standardization of ^{109}Cd sources for 88-keV γ-ray emission rate was performed using a NaI(Tl) well crystal which gave a nearly 4π geometry. Since the low-energy portion of the 88-keV γ-ray spectrum was obscured by 22-keV x-ray pulses, the total counting rate could not be found by merely summing the counting rates for all the channels in the distribution. A method, in which the spectrum was broken down into eight components, was used to determine the number of degraded 88-keV γ-ray pulses. The calibration was performed by summing the counting rates of the various components below an arbitrarily chosen energy of 39 keV, and adding them to the total counting rate above 39 keV. The process in which photoelectrons escaped into the aluminum liner of the well was found to be responsible for most of the degraded 88-keV γ-ray pulses which fell below 39 keV. The estimated systematic error in the measurement was ±0.9%. Using ^{57}Co sources which were accurately calibrated by coincidence counting, the 2-in. × 2-in. NaI(Tl) well crystal was shown to have a γ-ray detection efficiency of 100% with an uncertainty of ±0.2% (after corrections were made for well-wall γ-ray absorption and escape out of the well). The total abundance for the 122- and 136-keV ^{57}Fe photons emitted per decay from ^{57}Co was measured to be 0.963 ± 0.003. (auth) (UK)

270 PROCESS FOR THE FABRICATION OF ALPHA SOURCES. Cimetiere, Claudette; Desroches, Jean; Routier, Claude (to Commissariat a l'Energie Atomique). French Patent 2,041,947. 25 Jan 1971. Filed 28 May 1969. (In French).

A process for manufacturing α sources is described. The method consists of fixing onto a metallic or ceramic support a layer of an enamel containing ^{241}Am, in the form of americium silicate. This layer is obtained by melting an enamel powder containing ^{241}Am on the surface of the support. (France)

271 METHOD FOR THE PRODUCTION OF ^{60}Co SOURCES AND ELONGATED HOLLOW COILED WIRE TARGET THEREFOR. Ranschoff, Jackson A.; Lindbeck, Simon L. (to Neutron Products, Inc.). U. S. Patent 3,594,275. 20 Jul 1971. Filed 14 May 1968.

A unique method of producing cobalt-60 sources which accommodates both the needs of the reactor designer, the fuel cycle manager, and the cobalt-60 user is disclosed. The cobalt-60 source is produced by irradiating, in a nuclear reactor, natural cobalt wire which has been formed into a helical coil. The wire may be clad with a corrosion-resistant material before winding, or the spring may be encapsulated in a corrosion protective cladding after it has been formed. The cobalt-60 sources produced may be used in the same geometry in which they are irradiated, or the geometry may be changed prior to use to affect a different distribution of activity. (Official Gazette)

272 UTILIZATION OF ^{238}Pu AS HEAT SOURCE IN SPACE TRAVEL AND MEDICINE. Specht, S. (Technische Univ., Garching, Ger.). Atomwirt., Atomtech.; 16: No. 7, 365-70(Jul 1971). (In German).

Plutonium-238 represents a radionuclide that is eminently suitable as a long-lived reliable energy source. An additional advantage of ^{238}Pu is its property of being easily shielded. Despite its relatively high cost, the nuclide is, without competition, widely applicable in space travel and medicine. Up to 1980, NASA requirements alone are estimated at approximately 1 ton of ^{238}Pu. Utilization will become more economical through improvement of both production procedures and application systems. As a power source for cardiac pacemakers, ^{238}Pu can hardly be replaced by another radionuclide. In this field too, a significant market is projected. (tr-auth)

273 MINIATURIZED RADIOISOTOPE GENERATOR. Gemmill, Wayne J. (to Union Carbide Corp.). U. S. Patent 3,566,124. 23 Feb 1971. Filed 12 Apr 1968.

A nonshielded, miniaturized radioisotope generator for the production of radioisotopes having a nonhazardous level of radioactivity is described which is comprised of a closed container having an entrance port at one end, an exit port at the other end, and inner chamber communicating with the entrance and exit ports and an elutable radioactive material disposed in the generator in such a manner that the eluate can be withdrawn without contamination by the radioactive source. (Official Gazette)

274 MINIATURIZED ELECTRIC SOURCE. (to Baumgartner Freres SA). British Patent 1,235,090. 9 Jun 1971. Priority date 7 May 1969, Switzerland.

A miniaturized electric source comprising a beta source, collector, and output electrodes is described. The beta source is tritium which is chemically bound in a solid-state compound. (J.R.D.)

275 CHARGE REMOVAL FROM POWDER USING β-RADIATION. Sakanushi, Katsuhiro (Research Inst. of Industrial Safety, Tokyo). Funtai Kogaku; 7: No. 12, 44-6(Dec 1970). (In Japanese).

Charge removal from falling powder using β-particles was studied. In a sifter, powder was charged positively by friction while falling through the screen meshes; it was received in a Faraday cage below. A ^{90}Sr source, oblong in shape, was positioned either in parallel with or perpendicular to the direction of the falling powder. It was found that a parallel arrangement of the source is better than a perpendicular arrangement for charge removal; the residual charge is larger when initial charge on the powder is larger; when the charge on the powder is small, it is negatively charged due to beta particle attachment; the effect of charge removal is not influenced by the charge density; and the shorter the distance between the source and the falling powder, the higher the effect of charge removal. (Japan)

276 PROCESS AND DEVICE FOR THE SEPARATION OF GAS MOLECULES OF DIFFERENT MASSES. Campargue, Roger (to Commissariat a l'Energie Atomique). British Patent 1,247,069. 22 Sep 1971. Filed 17 Feb 1969.

The method described involves the use of supersonic gas jets. It may be employed as a general separation method, and is applicable to the separation of U isotopes. An auxiliary gas jet is produced in an atmosphere of the gaseous mixture. The jet comprises a supersonic central core, in which molecules of the lighter constituent become concentrated, bounded by a shock region. Extraction is from the central core region. The gaseous mixture flows around the jet and extraction of gas from the central core is carried out upstream of the leading face of the shock region. The required apparatus is described in detail. The auxiliary gas is preferably chosen so that it can be readily separated from the mixture, although it can be of the same nature as the mixture. A very high enrichment factor is claimed. In order to obtain maximum efficiency the pressure of the mixture within the apparatus casing should be maintained at a value lower than 10 mb but higher than 10^{-2} mb, in order that the mean free path of the auxiliary gas molecules is shorter than the diameter of the leading face of the shock region. Examples of the application of the method are given. (UK)

Materials Testing

Refer also to abstracts 235, 240, 241, 252, 374, 375, 377, and 481.

277 (INR-1204) RADIOGRAPHICAL CONTROL OF THICK-WALLED WELDS AND CASTINGS BY USE OF BETATRON. Janiczek, J.; Kielsznia, R.; Wolski, M. (Institute of Nuclear Research, Warsaw (Poland)). Sep 1970. 74p. (In Polish). INIS.

The operating principles of a betatron are given and aspects of radiographic investigations using betatrons are discussed. The results of application to these investigations of the Nuclear Research Institute betatron are summarized. Conclusions are formulated concerning the range of application of radiographic films available in the home market for industrial radiographic control using the betatron. Various types of betatrons and betatron laboratories are described. (auth) (INIS)

278 (SC-DC-705127) ULTRASONIC CHARACTERIZATION AND COMPUTERIZED ANALYSIS OF GRAPHITE BILLETS. Baker, R. A.; Bishop, D. E.; Stoker, G. C. (Sandia Labs., Albuquerque, N. Mex.). [1970]. 49p. Dep. NTIS.

A computer aided, ultrasonic test system for graphite billets has been developed, the primary purpose of which is to select the optimum location within the billet of a re-entry vehicle nose tip. An on-line mini-computer provides process control functions and initial data processing. Further data processing and billet quality analysis are provided by a large computer. Visualization of the internal structure is aided by the use of a computer-controlled plotter. The ultrasonic test system consists of a commercial ultrasonic tester with an automatic scanning and immersion system. Position readout indicators provide scan position and part rotation information. A special interface module receives ultrasonic test data from the tester and converts this information to analog voltages, while an auxiliary function module, controlled by the mini-computer, digitizes and records the position and ultrasonic information on magnetic tape. The large computer analyzes the ultrasonic flaw data in terms of the up to 3300 possible nose-tip locations within the billet. In evaluating each particular nose-tip location, every flaw indication is assigned a weight. These weights are totaled for that cone location. The 15 positions having the lowest weights are presented to the design engineer for his final selection. The plotter is used to provide graphic pictures of the flaws within the billet to aid the engineer in his selection of the optimum position of the nose tip. Plots are made showing all of the flaws in the billet by subdividing into slabs which run parallel to the billet axis and into discs perpendicular to the axis. Such plots show the flaw distribution in a clear, concise manner. Further programs plot histograms of the data with respect to three location parameters. (auth)

279 PROGRAMING DEVICE FOR THE X-RAY TESTING OF WELDED SEAMS AND PARTS. Kremnev, N. D. Sov. J. Nondestruc. Test. (Engl. Transl.); No. 2, 222-3(Mar-Apr 1969). Translated from Defektoskopiya; No. 2, 129-31(Mar-Apr 1969).

A self-acting carriage with remote control is used to convey parts for testing into the x-ray apparatus. The carriage imparts rotation to tubular objects as well as backward and forward motion. A programming device was developed in order to increase the efficiency and accuracy of placement under the x-ray beam. The operation of the device and carriage is described briefly. (D.L.C.)

280 EFFECTIVENESS OF USING BETATRONS FOR RADIOGRAPHY OF THICK METALS. Berdanosov, V. A.; Vorob'ev, V. A.; Gorbunov, V. I.; Pokrovskii, A. V.; Titov, G. V. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestruc. Test. (Engl. Transl.); No. 2, 232-4(Mar-Apr 1969).
Translated from Defektoskopiya; No. 2, 137-9(Mar-Apr 1969).

A study was made of the productivity, sensitivity, and cost of various betatrons (15, 25, and 30 MeV) for the radiography of steel, aluminum, and titanium with special emphasis on the effect of focal length. Ranges of thickness for 1% sensitivity are given, and productivity is calculated for various focal lengths. (D.L.C.)

281 EXPOSURE METER FOR BETATRON RADIOGRAPHY. Vasil'ev, V. D.; Samsonov, V. S.; Udralov, Yu. I.; Filippov, V. V. Sov. J. Nondestruc. Test. (Engl. Transl.); No. 1, 16-19(Jan-Feb 1970).
Translated from Defektoskopiya; No. 1, 20-4(Jan-Feb 1970).

The operating principles and construction of an electronic exposure meter intended for the automatic determination of the exposure time when x-raying materials and parts with betatron radiation are described. (auth)

282 SINGLE-CHANNEL NEUTRON FLAW DETECTOR. Elagin, V. B.; Pekarskii, G. Sh. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestruc. Test. (Engl. Transl.); No. 5, 553-6 (Sep-Oct 1969).
Translated from Defektoskopiya; No. 5, 52-6(Sep-Oct 1969).

A single-channel neutron-scintillation flaw detector is described for continuous testing of materials and articles. Effects of crystal thickness, discrimination threshold, and integral load on the radiation-detection efficiency are reported as is the size of the smallest flaw detectable during the testing of composite articles. (auth)

283 CHOICE OF OPTIMAL CONDITIONS IN ISOTOPE RADIOGRAPHY OF FLAT EXTENDED COMPONENTS AND HOLLOW BODIES OF ROTATION. Elisyutin, G. P.; Maiorov, A. N.; Tyufyakov, N. D. Sov. J. Nondestruc. Test. (Engl. Transl.); No. 6, 715-19(Nov-Dec 1969).
Translated from Defektoskopiya; No. 6, 86-92(Nov-Dec 1969).

The optimum collimation angle is calculated for planar extended components and hollow bodies of rotation, as well as the optimal conditions for examination. The restrictions on the choice of optimal conditions are discussed on the basis of the need to obtain the desired sensitivity over the whole picture and a permissible density difference between the center and edges of the radiograph. (auth)

284 RADIOGRAPHY OF STRUCTURAL ELEMENTS WITH ANISOTROPIC STRUCTURE. Firstov, V. G. Sov. J. Nondestruc. Test. (Engl. Transl.); No. 6, 712-14(Nov-Dec 1969).

Translated from Defektoskopiya; No. 6, 83-6(Nov-Dec 1969).

Some topics concerning radiographic inspection procedures in testing structural elements having an anisotropic structure are discussed, with cement concrete used as an example. The effect of inhomogeneities in the structure on the sensitivity of the method is analyzed, and recommendations are given on selecting the type of γ-ray flaw-detection instrument and radiation source. (auth)

285 SCHWARZSCHILD EFFECT IN NEUTRON RADIOGRAPHY. Bukarev, V. A.; Shtan, A. S.; Yaskevich, V. S. Sov. J. Nondestruc. Test. (Engl. Transl.); No. 2, 215-17(Mar-Apr 1969).

Translated from Defektoskopiya; No. 2, 121-4(Mar-Apr 1969).

Departures from reciprocity when PM-1 and Rapid RF2 x-ray-sensitive films are exposed in combination with ZnS(Ag) + ^{10}B (84.6% enriched) luminescent screens to slow neutron flux of 250-100 neutrons per $cm^2 \cdot sec$ intensity, with admixtures of gamma rays and fast neutrons, are investigated. (auth)

286 SCINTILLATION DEFECTOSCOPE USING A SHADOW CONTRAST IMAGE ON A CRT SCREEN. Pokrovskii, A. V.; Butakova, G. E.; Ivanchenko, Yu. P. (Tomsk Polytechnical Inst., USSR). Sov. J. Nondestruc. Test. (Engl. Transl.); No. 1, 112-13(Jan-Feb 1970).

Translated from Defektoskopiya; No. 1, 130-2(Jan-Feb 1970).

Experimental results are given from the testing of a defectoscope containing a scanning radiation receiver and a cathode-ray tube (CRT) as an indicator. A ^{137}Cs source was used and held stationary while the detector was moved. Steel arms were used to simulate defects. The CRT image was photographed; the sensitivity and resolution were found to be higher than in previous studied. (D.L.C.)

287 QUALITY ASSURANCE AND IN-SERVICE INSPECTION OF NUCLEAR PIPING. Wylie, Robert (Southwest Research Inst., San Antonio). pp 139-42 of Piping Systems. Chicago; Reinhold Publishing Corp. (1970).

From HPAC conference on piping systems; Chicago, Ill. (3 Nov 1969). See CONF-691134.

Quality assurance during construction and in-service inspection during operation are necessary to assure the reliability and safety of nuclear power plant piping systems. Both the ASME and ANSI have developed quality assurance standards for the materials, design, and construction of components in such piping systems. Methods are discussed for veryifying that these standards are met. In-service inspection requirements for nuclear piping systems have been defined by ANSI. Acoustic emission and ultrasonic methods for performing these inspections are described. (L.C.L.)

288 GAMMA RADIOGRAPHY. Langley, R. RCC Review No. 10. Amersham, Eng.: Radiochemical Centre (1971). 41p.

The fundamentals of radiography are briefly discussed and the differences arising from the use of a radioisotope rather than an x-ray machine as the radiation source are described. The required equipment is described in detail, including costs. Safety regulations are reproduced. (UK)

289 IMPROVEMENTS IN OR RELATING TO NEUTRON RADIOGRAPHY. Spowart, Alexander Rollo (to United Kingdom Atomic Energy Authority). British Patent 1,248,916. 6 Oct 1971. Filed 14 Mar 1968.

In the method described a beam of polychromatic neutrons is employed having at least in part epithermal energies above the absorption resonance of the material examined. The neutrons are filtered through Cd between the neutron source and the object examined to produce an epicadmium neutron flux, and the neutrons reaching the detector are mainly of energies >0.4 eV. In this way the limits of penetration in thermal neutron radiography are extended. By using slightly higher than thermal energy neutrons advantage can be taken of a decrease in cross section of certain materials in the energy range 0.4 to 10 eV, and by using a Cd filter the detector will respond only to neutrons >0.4 eV. A simple Cd window of large area may be employed and the need for scanning the object is thereby reduced. The method finds application to highly absorbing nuclear fuels, hydrogenous materials, plastics, rubber, etc., and the application may be widened by using a fissile epicadmium neutron booster. It is found to be an efficient epicadmium neutron detector. Detection techniques are described. (UK)

290 SHEAR STRENGTH OF BERYLLIUM, URANIUM, AND TUNGSTEN AS A FUNCTION OF STRAIN, STRAIN RATE, AND PRESSURE. Abey, A. E.; Stromberg, H. D. (Univ. of California, Livermore). J. Basic Eng.; 93: No. 2, 291-5(Jun 1971).

The shear strengths of beryllium, uranium, and tungsten were measured at strain rates of 3.5×10^{-5}, 3.6×10^{-3}, and 3.7×10^{-1} sec^{-1}. The measurements were taken under nearly hydrostatic pressures of 21, 44, and 63×10^8 N/m^2. The shear strength versus shear strain curves are presented along with the pressure and in strain rate derivatives of the experimental parameters. (auth)

291 FRACTURE SAFETY ANALYSIS CONCEPTS FOR NUCLEAR PRESSURE VESSELS, CONSIDERING THE EFFECTS OF IRRADIATION. Merkle, J. G. (Oak Ridge National Lab., Tenn.). J. Basic Eng.; 93: No. 2, 265-73(Jun 1971).

One of the most important aspects of the growth of nuclear power has been the development and use of quantitative methods of analysis for insuring the reliability of plant components and for protecting the public health and safety. Nuclear pressure vessels have always received close attention with regard to their structural strength and reliability. Some of the fracture mechanics concepts now being considered for application to the safety analysis of nuclear pressure vessels are summarized. The effects of thickness, temperature, strain rate, and irradiation on fracture toughness are discussed in terms of their relevance to a safety analysis. The amount of neutron irradiation likely to be received by a light water reactor pressure vessel is examined in terms of reactor type and the thermal power level. The ranges of temperature and fluence that are of most importance with regard to irradiation effects data on pressure vessel steels are identified. An example safety analysis problem is included to illustrate the application of the concepts discussed. (auth)

292 USE OF FRACTURE MECHANICS IN REACTOR VESSEL SURVEILLANCE. Mager, T. R.; Yanichko, S. E. (Westinghouse Electric Corp., Pittsburgh). J. Basic Eng.; 93: No. 2, 259-64(Jun 1971).

The basis for utilizing fracture mechanics technology based upon data obtained from small Charpy V-notch specimens incorporated in reactor vessel surveillance programs is described. Included is a brief background on linear elastic fracture mechanics and a discussion of reactor surveillance programs in general. Data obtained from published literature are organized and an empirical approach is proposed to utilize the fracture mechanics technique in surveillance programs. A typical problem is included to demonstrate that the approach discussed can be successfully applied to nuclear pressure vessel safety analysis. (auth)

293 REASSESSMENT OF FRACTURE-SAFE OPERATING CRITERIA FOR REACTOR VESSEL STEELS BASED ON CHARPY-V PERFORMANCE. Loss, F. J.; Hawthorne, J. R.; Serpan, C. Z. Jr. (Naval Research Lab., Washington, D. C.). J. Basic Eng.; 93: No. 2, 247-58(Jun 1971).

Fracture-safe operating criteria for commercial nuclear pressure vessels based on fracture analysis diagram procedures and Charpy-V energy trends are reappraised with respect to the effects of thick section mechanical constraint and low Charpy-V shelf energies resulting from neutron irradiation. Comparisons of the Charpy-V test with the more definitive dynamic tear test procedures indicate the former to be an acceptable means of assessing the fracture toughness of A533-B steel. The mechanical constraint associated with 12-in. thicknesses of this steel suggests the addition of 70°F to the existing criterion requiring vessel operation above NDT + 60°F. Ratio analysis diagram procedures are shown to be useful in interpreting Charpy-V shelf level data obtained from vessel surveillance programs in terms of critical toughness levels relating to brittle fracture. (auth)

Radioactive Material Handling

Refer also to abstracts 1, 196, 232, and 600.

294 (IAEA-R-817-F) A FEASIBILITY STUDY OF SAFEGUARDS SYSTEMS FOR A PLUTONIUM FUEL DEVELOPMENT FACILITY. Final Report, December 1, 1969–November 30, 1970. Nakamura, Yasuji (International Atomic Energy Agency, Vienna (Austria)). Dec 1970. 82p. INIS.

The following items are discussed: An investigation of the material flow in the facility in order to correlate the value of material unaccounted for (MUF) with the amount of materials handled at each processing step in a specified period; verification of the physical status and determination of the plutonium

content of all kinds of product and radioactive waste; estimation of measurement errors or uncertainties related to obtaining data for a material balance; and computer simulation of material flow and accountability procedures. Four kinds of fuel with different plutonium contents are considered, namely, fuel for two region critical experiments, for Rapsodie irradiation, for Saxton irradiation, and for Dounreay Fast Reactor irradiation. Total amount and distribution of MUF in each process step in four cases are summarized and are given, as well as analytical results and data of physical inventories taken in 1969 and 1970. In estimating measurement errors several analytical methods for uranium and plutonium determination are considered. A computer simulation code was developed for calculating MUF values which can be computed with data from physical inventories for the present system and for estimating MUF values for a new plutonium facility. (INIS)

295 (LA–4794) NUCLEAR SAFEGUARDS RESEARCH AND DEVELOPMENT. Program Status Report, May–August 1971. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. 31p. Dep. NTIS.

Research and development progress are reported on neutron interrogation and nondestructive methods for analysis of fissionable materials; radioactive sources for nondestructive assay applications; passive neutron, gamma, and x-ray assay applications; detector and instrumentation development; analytical studies and computational methods; and the mobile nondestructive assay laboratory (MONAL). (R.C.K.)

296 (LBL–2) COMPLETE CONTROL OF TRITIUM WATER VAPOR BY THE USE OF SILICA GEL. Aune, Raymond G.; Cantelow, Herbert P.; Boltin, Richard L. (California Univ., Berkeley. Lawrence Berkeley Lab.). 30 Aug 1971. Contract W-7405-eng-48. 19p. (CONF-710809–7). Dep. NTIS.

From Tritium symposium; Las Vegas, Nev. (30 Aug 1971).

A new system has been developed to capture tritiated water vapor that normally would be released to the environment during glove-box operations. Columns of silica gel are connected to the exhaust lines, and essentially all the tritium released in the box is captured. The silica gel can initially be in equilibrium with atmospheric humidity without impairment of its capacity for absorbing tritiated water. This means that the silica gel can remain connected to the exhaust line for an indefinite period of time and still be ready for active operation. In application of the system, standard pipefitting techniques can be used for transferring tritiated water of very high specific activity without allowing any tritium to escape with the exhaust air. For convenience and economy, the silica gel columns are designed so they can easily be emptied and refilled without removing the columns from the system. It was found that the silica gel can be used as a convenient room sampler for tritium. (auth)

297 (ORNL–TM–3544) OAK RIDGE NATIONAL LABORATORY RETURNABLE TYPE B GAS SHIPPING PACKAGE. Seagren, R. D. (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 33p. Dep. NTIS.

An analytical evaluation of the ORNL Returnable Type B Gas Shipping Package was made to demonstrate its compliance with the regulations governing packages in which radioactive material is shipped. Comparative data were used to demonstrate the structural integrity and thermal behavior of the packaging with respect to the general standards for packaging, structural standards, standards for normal conditions of transport, and the standards for the hypothetical accident conditions. The results of this evaluation show that the packaging complies with all applicable regulations. (auth)

298 (RMO–3009) REPORT OF PRACTICABILITY STUDY AND COST ESTIMATE. REMOVAL OF URANIUM MILL TAILINGS FROM UNDER OR NEAR CERTAIN RESIDENCES IN THE GRAND JUNCTION, COLORADO AREA. (Nelson, Haley, Patterson and Quirk, Inc., Grand Junction, Colo.). Sep 1971. Contract AT(05-01)-1612. 33p. Dep. NTIS.

Methods and estimated costs of removal of uranium mill tailings under and adjacent to residences in and about Grand Junction, Colorado, are reported. Estimates of cost of removal of tailings from all types of locations in which they have been found are included. (P.C.H.)

299 (RT/PROT–(70)-34) RADIOACTIVE SOLID WASTE DISPOSAL INTO THE OCEANS: IMPLICATIONS AND PERSPECTIVES. Polvani, Carlo (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). [1969]. 20p. (CONF-690666–1). Dep. NTIS (U. S. Sales Only).

From Symposium on the international regime of the sea-bed; Rome, Italy (30 Jun 1969).

After a brief introduction to the technical problems arising from the sea disposal of solid radioactive wastes on the continental shelf as well as in deep basins, the present knowledge of the fate of packaged materials disposed of in the sea was taken into consideration. The study of this fate is important from the radiological protection's point of view also considering the evolution of the use of disposal areas. Sea disposal operations practiced during the past twenty-five years are summarized. At last, the international regime of dumping is discussed in the framework of international agreements. (auth)

300 (UJV–2514–Ch) DESIGN OF FACILITY FOR FIXING RADIOACTIVE WASTES IN BITUMEN. Napravnik, J.; Ralkova, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 9p. (In Czech). INIS.

Calculations and results of laboratory-scale experiments carried out with bitumen samples produced by PARAMO Pardubice and with bitumens with an increased content of paraffin and/or $NaNO_3$ proved the feasibility of fixation of radioactive wastes with a final fission product activity of 20 to 80 Ci/kg in bitumens without marked radiation damage or other changes that might negatively affect the technological procedure. This procedure consists in heating a bituminous emulsion with radioactive concentrates to 140°C with intensive stirring. Additional evaporation of water takes place. Condensed water is returned into the process as low-level waste and the bituminous mixture is poured into storage vessels. Owing to liberation of gases resulting from radiation damage of hydrocarbons, samples with increased paraffin content could not be used. Assuming the content of the main components in the wastes to be 0.6 M Mg^{2+} and 1.2 M HNO_3 in an aqueous solution with specific activity of 20 to 80 Ci of fission products per kg, 3 kg of fixed mixture could be produced per shift. (INIS)

301 SOLIDIFICATION OF PLUTONIUM LIQUID WASTES IN BOTTLES. Aikawa, Hideaki; Kato, Kiyoshi; Wadachi, Yoshiki (Japan Atomic Energy Research Inst., Tokai). Hoken Butsuri; 5: No. 4, 199-203(Dec 1970). (In Japanese).

A technique for the solidification of plutonium liquid wastes in battles for safe transportation and storage is described. Experiments were carried out on the physicochemical properties of materials concerning the solidification of wastes. It was found that vermiculite is superior to water absorbability, water permeability, acid resistibility, and plutonium absorbability, and that plaster was excellent in solidifying ability over a wide range of acidity. A mixture of vermiculite and plaster with an optimum composition was useful for the solidification of wastes. In conclusion, the best result was obtained by pouring the wastes into a mixture consisting of vermiculite and plaster in a 1:1 ratio by volume. The volume of the wastes poured was limited to one-half as compared with the volume of the mixture. Furthermore, a practical procedure for solidification in bottles and safety controls regarding storage disposal of the resultant wastes are described. (auth) (Japan)

302 ISOTOPE TRANSFER DEVICE. (to Picker-Andrex X-ray A/S). British Patent 1,247,044. 22 Sep 1971. Priority date 19 Oct 1967, Denmark.

An isotope transfer device is described in which a radioactive isotope is positioned when in a protective container or an exposure container and by means of which device the isotope may be transferred from the protective to the exposure container, said device comprising a protective sheathing with a longitudinal channel in which the isotope is disposed at the end of a displaceable rod, so as to be movable between a retracted position relatively far from a radiation aperture in the protective sheathing and an extended position opposite the radiation aperture. It is the aim of this invention to provide an isotope transfer device of the said type which minimizes the risk of radiation for the users. (L.C.L.)

303 APPARATUS FOR MANIPULATING RADIOACTIVE MATERIAL TO AND FROM A STORAGE UNIT. Perry, George J. (to Technical Operations Inc.). U. S. Patent 3,593,594. 20 Jul 1971. Filed 4 Oct 1968.

Apparatus for manipulating radioactive materials to and from a storage unit and more particularly, novel features in a coupling unit for coupling propulsion means for the source to the source and its storage unit are described. Structures are shown for rendering the coupler fail-safe to prevent coupling of the propulsion means with the storage unit unless a propelling cable and the source are properly connected; other structures are shown for preventing decoupling except when the source is in its storage unit and for facilitating connection of the propelling cable with the source. (Official Gazette)

304 IMPROVEMENTS IN THE INSULATION OF PACKAGES FOR THE CONFINEMENT OR TRANSPORT OF RADIOACTIVE

MATERIALS. (to Robatel-SLPI). French Patent 2,040,728. 11 Jan 1971. Filed 22 Apr 1969. (In French).

In this process for thermally insulating packages containing radioactive materials, a mass of wet plaster is run into the empty space between the lead shielding and the external metallic envelope of the package. The excess water found after the hardening of the plaster is eliminated, and in the porous mass formed, a liquid product having a boiling point corresponding to a temperature at which the insulation is intended to be used is introduced. (France)

305 TRANSIT RECEPTACLE FOR RADIOACTIVE SUBSTANCES, AND A TRANSFER METHOD AND APPARATUS MAKING USE OF THIS RECEPTACLE. Delfosse, Jean; Premartin, Etienne (to Commissariat a l'Energie Atomique). British Patent 1,234,020. 3 Jun 1971. Priority date 28 Apr 1969, France.

An invention is described which provides a transit receptacle for radioactive substances comprising a gamma shielding flask having a removable upper plug and defining a compartment, and an ash can housed in the compartment in the flask, removable from this compartment and closable by means of a fluid-tight upper cover which is opposite the plug when the ash can is in the flask, characterized in that at least the upper portion of the side wall of the ash can is thin and made from a resiliently deformable material. The cover and the upper portion are such that the cover snaps into the ash can in a substantially fluid-tight manner when pushed into the ash can by means of a push rod displaceable axially towards the ash can in a member which can be fixed relatively to the flask. An object of the invention is to provide a transit receptacle for radioactive substances, more particularly radioactive waste, which fulfils practical requirements better than those previously proposed, especially by providing satisfactory protection at relatively low cost and giving high reliability in use over a long period. (L.C.L.)

306 METHOD OF MAKING MEANS FOR VENTING HELIUM FROM A RADIOISOTOPE CONTAINER. Anderson, Charles G. (to United States Atomic Energy Commission). U. S. Patent 3,578,442. 11 May 1971. Filed 15 Oct 1968.

Filter means and method for venting helium gas through a radioisotope container wall and preventing or minimizing escape of radioisotopes and radioactivity is described. The device is comprised of a porous tablet forming a part of the wall including a pressed and sintered particulate blend of a refractory metal and a heat resistive material to provide porosity and strength at elevated temperatures. (Official Gazette)

307 IMPROVEMENTS TO MANIPULATORS. (to Commissariat a l'Energie Atomique). French Patent 2,038,857. 28 Dec 1970. Filed 31 Mar 1969. (In French).

The movements made by an operator to this articulated manipulator assembly situated on the outer side of a cell wall are transmitted through the wall to a second articulated assembly reproducing the movements of the first. The master part consists of an arm parallel to the cell wall and articulated to a tube traversing this wall. (France)

308 RADIOACTIVE CARGOES: RECORD GOOD BUT THE PROBLEMS WILL MULTIPLY. Shapley, Deborah. Science; 172: No. 3990, 1318-22(25 Jun 1971).

A review of experience in shipping radioactive materials is presented. Included are discussions of past incidents and predictions of future hazards. It is noted that future shipments of Pu may give rise to the greatest concern. (J.R.D.)

309 ORIGINAL EQUIPMENTS OF THE ISIDORE HOT CELLS. Brebant, C (CEN de Cadarache, Saint-Paul-les-Durance, France); Plumejeau, J.; Ramus, P.; Roussel, E. Bull. Inform. Sci. Tech. (Paris); No. 157, 45-59(Mar 1971). (In French).

Certain original items of equipment were included in the construction of the unit Isidore. Their purpose is to increase the versatility of operation; use the volume of a cell efficiently; enhance personnel safety; and improve techniques of examinations in the cell. (France)

310 ELECTRICALLY OPERATED GRAPNEL FOR FUEL RODS. Briot, Paul-Marie Henri (to Groupement Atomique Alsacienne Atlantique). French Patent 2,036,700. 31 Dec 1970. Filed 26 Feb 1969. (In French).

The addition concerns the elimination of the inconveniences encountered in the operation of a grapnel, principally envisaged for the handling of fuel rods in the channels of a reactor, cooled by the circulation of gas under pressure. Each gripping claw has aerodynamically streamline design based upon an experimentally determined curvature. (France)

311 DEVICE FOR INTRODUCING AND TRANSFERRING RADIOACTIVE SAMPLES BETWEEN TWO PROTECTION ENCLOSURES. Bertoni, Bruno; Delfosse, Jean (to Commissariat a l'Energie Atomique). French Patent 2,052,026. 29 Mar 1971. Filed 7 Jul 1969. (In French).

Equipment for introducing radioactive samples into enclosures which afford protection against γ radiation is described. This equipment also facilitates the transfer of samples from a protection cell to a glove box. An intermediate adjoining chamber is provided with a door for introducing the sample and doors leading to both enclosures. The sample is contained inside a cask which is placed on a moveable conveyor in this intermediate chamber. A device associated with this conveyor disconnects either enclosure from the intermediate enclosure and actuates the locking and unlocking of the entrance and exit doors. (France)

312 IMPROVEMENTS TO THE METHODS AND DEVICES FOR MOUNTING SEALING RINGS AND ANALOGOUS SYSTEMS IN RADIOACTIVE ENCLOSURES. Townsend, Eric (to Commissariat a l'Energie Atomique). French Patent 2,041,558. 18 Jan 1971. Filed 29 Apr 1969. (In French).

In this process for the mounting of extensible rings with articulated elements in order to ensure the biological sealing at the entrance of radioactive enclosures, the ring is mounted in a collar whose surface bearing is recessed and exterior to the peripheral surface of the enclosure entrance. (France)

Vacuum Engineering

313 IMPROVEMENTS TO ION PUMPS. Berge, Louis; Jalenques, Francois. French Patent 2,041,373. 18 Jan 1971. Filed 22 Apr 1969. (In French).

An ion pump for ultrahigh vacuum applications (10^{-10} to 10^{-12} torr) is described. The pump possesses a grid composed of a getter material, such as titanium, which is mounted between an anode, and a cathode made of a getter material. Ions accelerated by a magnetic field between the cathode and anode pass through the gaps in the grid. The side of the grid facing the cathode presents to the ions reflected from the cathode a surface sheltered from direct ion bombardment. The anode can be constructed in the form of a honeycombed surface juxtaposed cylindrical rings. The gettering grid which is mounted in front of, and parallel to, the cathode possesses circular holes which are coaxial with the anode rings. The holes in the gettering grid have diameters smaller than those of the corresponding anode rings. (France)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 282 and 295.

General Detectors and Monitors

Refer also to abstracts 269, 360, 394, 813, 1175, 1336, and 1562.

314 (EURFNR-901) MONTE-CARLO CODE FOR THE EVALUATION OF THE EFFICIENCY OF A B-NaI NEUTRON COUNTER. Brandl, V. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Translation of report KFK-1182. 37p. Dep. NTIS.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A Monte Carlo code for the evaluation of the efficiency of a B-NaI neutron counter is described. The counter detects the 478-keV gammas from the sequence of reactions: $^{10}B + n = {}^{7}Li^{*} + \alpha + 2.3$ MeV; $^{7}Li^{*} \rightarrow {}^{7}Li + \gamma + 478$ keV. Multiple elastic scattering of the neutrons on ^{10}B and $(CH_2)_n$ is taken into account exactly by the code. For an arbitrary energy group of the neutrons the detector efficiency is, in principle, evaluated by an analog Monte Carlo method. In all other energy groups the efficiency is simultaneously computed by sampling of corresponding weights. The most important input data of the code are the geometry of the counter and the nuclear cross sections of its constituents. (auth)

315 (FRNC-TH-43) CONSTRUCTION AND CALIBRATION OF A HYDROGEN PROPORTIONAL COUNTER FOR ENERGY AND FLUX MEASUREMENTS WITH MONOENERGETIC NEUTRONS BETWEEN 100 AND 500 keV. Sumeire, Claude (Grenoble Univ. (France). Faculte des Sciences). 1970. 199p. (In French). (IDE-4). Dep. NTIS (U. S. Sales Only).

Thesis.

A cylindrical, hydrogen-filled proportional counter for measurements on monoenergetic neutron fluxes in the 100 to 500 keV range is described. This counter was chosen, in spite of its delicate construction, because the type of measurements usually made with fast neutrons with higher energies (3 and 14 MeV for example) are unsuitable in this energy range owing to low resolution and lack of efficiency. A preliminary study using the classical Townsend expression for the coefficient of electron multiplication of the gas associated with a minimum pressure constraint allowed the values of the geometric parameters for the mechanical construction. Under operating conditions p = 0.9 atmospheres of H_2 and V_0 = 2000 volts, with a monoenergetic neutron flux in the $1.5 \cdot 10^{13}$ to $5 \cdot 10^{5}$ neutron/sec range with an energy between 100 and 500 keV, adjacent spectra differing by one thirtieth of a keV can be distinguished (i.e. the resolution is about 3 percent at 500 keV). The apparatus has the following characteristics: a response varying linearly with the neutron energy (spread less than 10 keV), and a capability of yielding accurate values for the neutron dose rate. The concealed alpha source produces a calibration peak from which the neutron energy may be obtained. (France)

316 (INMAS/HP-13-70) A PRELIMINARY STUDY OF WHOLE BODY COUNTING IN THE "BUDDHA POSTURE." Gupta, M. M.; Jain, S. C.; Shukla, K. K.; Nagaratnam, A. (Institute of Nuclear Medicine and Allied Sciences, Delhi (India)). 1970. 6p. (CONF-701138-1). INIS.

From National symposium on radiation physics; Bombay, India (24 Nov 1970).

An attempt to improve the responses of whole-body counters by modifying the Marinelli (or standard chair) geometry to the Buddha Posture (posture of sitting cross-legged) is described. The gamma scintillation spectra of each of the three isotopes ^{137}Cs, ^{131}I and ^{60}Co were studied in three energy bands, one at the photo-peak of the isotope and around 110 keV and 200 keV, which gave similar results. It was observed that, whereas in the standard chair geometry the response falls rapidly as the source position changes from the knee to the toes, in the Buddha posture the count-rate does not reduce much from knee to the toes. For activity concentrated in the legs, the increase in count-rate in the Buddha posture was nearly 40% more and it was computed that, if the activity were uniformly distributed in the whole body, the increase in count-rate would be about 13%. (INIS)

317 (JINR-P6-6052) SHAPER OF PULSES FROM THE SEMICONDUCTOR RADIATION DETECTORS WITH RC AND RLC CHAINS. Ormandzhiev, Slavko Ivanov (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

A system consisting of RC and RLC chains used for pulse shaping from semiconductor detectors is studied. The formulae are derived for calculating the noise/signal ratios and for determination of the resolving time of the shaping system. A possibility is considered for compensating the effect of the differentiation in the preamplifier on the output pulses from the shaper. Some recommendations on constructing the amplifier based on the shaping of this type and the block diagram of this amplifier are given. (auth)

318 (KFK-1388) STRIP SEMICONDUCTOR DETECTORS WITH DIGITAL POSITION READOUT. Fawzi, M.; Haase, A.; Haase, E. L.; Saylor, D. P.; Velten, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). May 1971. 13p. (In German). (CONF-710333-2). Dep. NTIS (U. S. Sales Only).

From Meeting on nuclear physics; Wuerzburg, Germany (2 Mar 1971).

Solid state detectors with digital position read out were developed to permit the simultaneous measurement of several angles, or the increase of solid angle without increasing the kinematic spread. The counters are large area ion-implanted detectors with a common aluminum contact and a front contact consisting of five or twelve gold strips separated by 0.2 mm. The analog signal is taken in common for all strips from the aluminum contact, and from each strip the position information is picked off via a fast charge sensitive preamplifier. This information is reduced to digital form and stored in discriminator-coincidence-buffer units. At high count rates, these detectors provide immediately available position signals and they permit the elimination of errors and background arising from collimator scattering. (auth)

319 (N-71-23959) MICROWAVE CAVITY FOR MEASUREMENT OF IONIZATION DUE TO MeV ELECTRON BEAM. Dayton, James A, Jr. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr 1971. 5p. (NASA-TM-X-2279). NTIS.

A microwave cavity which can be penetrated by an electron beam in the MeV range and which can be evacuated to 10 to the minus 8th power torr and baked at 200°C is described. The electron beam is admitted through a titanium foil welded to one end of the copper body of the cavity. Targets of a variety of materials may be brazed to the other end. The design permits all brazed joints to be thoroughly cleaned before the final seal, an electron beam weld, is made. (STAR)

320 EQUIPMENT FOR THE AUTOMATIC STABILIZATION OF THE DISPLACEMENT IN NUCLEAR RADIATION PROBES. Fritz, Berthold; Trost, Adolf (to Firma Laboratorium). French Patent 2,003,773. 14 Nov 1969. Priority date 13 Mar 1968, Austria.

An installation for the automatic stabilization of the displacement in the measurement of radiation intensity with probes whose output pulses are dependent on the absorbed energy is described. The installation uses a radiation source in a position defined with respect to the probe. The radiation source has an energy at least equal to the maximum energy to be measured. The installation has an integrator discriminator and a control circuit for the amplification of the pulse height which keeps the pulse rate registered by the discriminator constant. (J.S.R.)

321 EXPERIMENT TO STUDY COSMIC GAMMA RADIATION WITH A NUCLEAR EMULSION-SPARK CHAMBER SYSTEM. Roy, Subrata Kumar. St. Louis; Washington Univ. (1971). 186p. University Microfilms Order No. 71-19,829.

Thesis.

An experimental attempt to detect cosmic gamma rays with a nuclear emulsion-spark chamber system at balloon altitude is described. For gamma ray energy above 50 MeV, detection is accomplished by the dominant pair-production process. The associated spark chamber aids in locating the electron pair in the emulsion. The merits of such a detection system for discerning a small gamma-ray signal in the large atmospheric secondary gamma-ray background are discussed. This system, with an opening cone of about two sterad, a high potential angular resolution of about 10^{-3} radian, approximate energy threshold of about 50 MeV, and an average conversion efficiency of about 50%, is found to be suitable for survey-type work in the search for prospective gamma-ray sources. The results from the experiment, conducted from a balloon flown to an atmospheric depth of

2.4 g/cm^2 on September 29, 1967, are presented. The feasibility of the detection system is investigated using the limited statistics available from this partially successful balloon flight. It is shown that such a system is capable of solving various problems connected with detection techniques in gamma-ray astronomy. The isotropic gamma-ray intensity above 50 MeV, presumably of atmospheric origin, was found to be $(4.3 \pm 0.4) \times 10^{-3}$ gamma photons/cm^2-sec-sterad at an atmospheric depth of 2.4 g/cm^2. No potential point sources of gamma rays were observed. (Diss. Abstr. Int.. B)

322 DETERMINATION OF THE THERMAL NEUTRON FLUENCE BY COBALT ACTIVATION MONITORS. Koehler, W. (IAEA, Vienna); Vaninbroukx, R. Int. J. Appl. Radiat. Isotop.: 22: No. 9, 529-41(Sep 1971).

The determination of the thermal neutron fluence by cobalt activation monitors is an usual practice in reactor irradiation experiments. To facilitate a more uniform presentation and intercomparison of the experimental data the Working Group on Reactor Dosimetry elaborated recommendations for the experimental procedure concerning special types of monitors, measurement of the induced activity by comparison with calibrated ^{60}Co standards, nuclear constants to be used and corrections. In addition to pure cobalt monitors (discs: 0.1 mm thick, 3 mm or 10 mm dia.; wires: 10 mm long, 0.125 mm dia.), aluminium−1% cobalt discs (0.1 mm thick, 10 mm dia.), prepared by CBNM, and aluminium−0.1% cobalt wires (10 mm long, 0.5 mm dia.), offered by NBS, are recommended. The ^{60}Co standards distributed in 1963 were calibrated by the CBNM; in 1969 the IAEA offered four types of ^{60}Co-standards pursuant to these recommendations. The main nuclear constants involved in the method are the thermal activation cross section of ^{59}Co, $\sigma_0 = 37.3 \pm 0.2$ barns; the half-life of ^{60}Co, $T_{\frac{1}{2}} = 5.28 \pm 0.01$ yr; and the thermal absorption cross-section of ^{60}Co, $\sigma_1 = 2.0 \pm 0.2$ barns. The values of the correction for the diminution of ^{59}Co and ^{60}Co are given as well as those of the correction for the flux perturbation by the monitors. The correction for epithermal activation must be determined for each experiment. An overall accuracy of ±2% can be obtained; ratios of fluence values, however, can be determined with an accuracy better than ±1%. (auth)

323 CHARACTERISTIC CURVE OF ELECTRONOGRAPHIC EMULSIONS. Bijaoui, A. (Observatoire, Paris). Nouv. Rev. Opt. Appl.; 2: No. 3, 169-73(May 1971). (In French).

The action of mean energy electrons (25 keV) on photographic emulsions was studied experimentally. An Ilford G 5 emulsion was investigated. In order to interpret the characteristic curves, an element of volume in which all the grains are blackened is considered to behave as if it were not completely opaque. Two models are considered: the blackened emulsion has an absorption coefficient k; the developed silver grains have a transparency τ. The second model is the more realistic but the experimental results are in better agreement with the first. This model was applied to an Ilford K 5 emulsion which corresponds to a non-single hit process; in this case the agreement between experiment and theory was good. (France)

324 SEMICONDUCTOR DETECTION DEVICE FOR IONIZING RADIATIONS. Meuleman, Johannes; Forcinal, Gerard (to RTC La Radiotechnique-Compelec). French Patent 2,041,718. 5 Feb 1971. Filed 12 May 1969. (In French).

A semiconductor detector for ionizing radiations and especially intended for γ ray spectrometry is described. It was designed in view of eliminating the peak due to Compton scattering. It consists of two semiconductor detectors of the NIP type, one surrounding the other. Both detectors were made from a cylindrical semiconductor rod (a single Ge crystal) and consist of three almost annular, concentric layers of N, I, and P types respectively. The layer with the intrinsic conductivity is Li drifted. The P type layers are obtained by doping using a metallic film (Ga−In eutectics for instance). One of the detectors is inserted in a hollow in the other. The axis of this hollow is parallel to the axes of the layers of both detectors. The opposite layers of the detectors are of the same type. (France)

325 SURFACE BARRIER SEMICONDUCTOR DETECTOR. Meuleman, Johannes (to La Radiotechnique Compelec). French Patent 2,049,382. 15 Mar 1971. Filed 9 Jun 1969. (In French).

A low background surface barrier detector which can be used at low temperatures is described. This detector is made of a given type semiconductor crystal. On its first face, a thin localized inversion film which forms with the crystal a junction at least partially covered with a contact metal plate is deposited. On its second face, a second contact metal is deposited. A polarized tension is applied between the two plates in order to create on both sides of the junction a deserted region bounded on the second face by a nondeserted region. (France)

326 LOGIC UNIT FOR HANDLING THE DATA GIVEN BY NUCLEAR DETECTORS. Pages, Roland (to Societe d'Applications Industrielles de la Physique). French Patent 2,051,898. 29 Mar 1971. Filed 1 Jul 1969. (In French).

A logic unit for handling the information given by nuclear detectors is described. It can be especially applied to multiple proportional chambers (wire chambers). Arrangements are designed for reducing the resolution time and the time for memory scanning. Furthermore, all the data are placed in the memory whether the event is considered interesting or not. (France)

327 STUDIES ABOUT RESOLUTION CONCERNING FOCUSING COLLIMATORS OF MAGNA SCANNERS WITH COLUMNAR PHANTOM. Schroeder, H. (Berufsgenossenschaftliche Krankenanstalte, Bochum, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed.; 115: No. 2, 256-9(Aug 1971). (In German).

The resolution of collimators of various focusing types under varying conditions were investigated. For those experiments ^{125}I, ^{99}Tc, ^{131}I and ^{113}In were used. Test objects were plastic columns 1 to 10 cm. high and with diameters of 1, 2 and 3 cm. (auth)

328 CALIBRATION OF AN IONIZATION CHAMBER BY COMPARISON WITH $FeSO_4$ FOR HIGH ENERGY ELECTRON BEAMS. Wambersie, A. (Cancer Inst., Louvain, Belgium); Dutreix, A.; Prignot, M.; Dutreix, J. Stud. Biophys.; 26: No. 3, 167-77(1971).

Calibration of an ionization chamber (Baldwin type) for high energy electron beams is made by comparison with chemical dosimetry ($FeSO_4$). Measurements have been made for 6 to 30 MeV, the response of the $FeSO_4$ solution is assumed to be independent of the electron energy in the concerned energy range (G = 15.5). The results are compared with other published values obtained with $FeSO_4$ and with theoretically expected values. (auth)

329 DEVICE FOR IONIZING RADIATION DETECTION. Meuleman, Johannes (to La Radiotechnique Compelec). French Patent 2,050,239. 2 Apr 1971. Filed 7 Jul 1969. (In French).

A device for ionizing radiation detection with an optimal efficiency is presented. It consists of a scintillator and a junction photodiode made in a semiconducting body. The semiconducting body comprises a well opening in the face of the photodiode directed towards the incident radiations and enveloped by the detecting junction. The scintillator is housed inside the well. (France)

330 OPTIMAL CONDITIONS FOR MEASURING LOW ACTIVITY SAMPLES OF SHORT HALF-LIFE RADIOISOTOPES. Bartoşek, Jiri; Kasparec, Ivan (Inst. of Applied Geophysics, Brno). Jad. Energ.; 17: No. 8, 274-5(Aug 1971). (In Czech).

The relationship between the accuracy and the measuring time of low-activity samples of short-half-life radioisotopes is studied. The optimum measuring time for low-activity samples equals two half-lives; for more active samples, three half-lives. The condition minimizing the relative error is not very critical. (auth)

331 ELECTRON MULTIPLIER RESPONSE UNDER POSITIVE ION IMPACT. I. SECONDARY ELECTRON EMISSION COEFFICIENTS. Van Gorkom, M.; Glick, R. E. (Florida State Univ., Tallahassee). J. Mass Spectrom. Ion Phys.; 4: No. 1-2, 203-18(Oct 1971).

Secondary electron emission coefficients deduced from the impact of atomic, diatomic, and polyatomic ions in the 2 to 10 keV kinetic energy range impinging on the first dynode of a twenty dynode electron multiplier have been determined under standard mass spectrometer detection conditions. As the studies were made on gas covered surfaces, kinetic emission dominated. The theory of Parilis and Kishinevskii described the atomic results by accounting for the linear dependence of the emission coefficient with impact ion velocity, the dependence of the slope of the linear region on the nature of the impacting ion and a constant intercept velocity for all atomic ions, 0.4×10^7 cm sec^{-1}, as determined by extrapolating the linear section of the efficiency versus velocity plots to the threshold for the process. Diatomic and polyatomic ions were more efficient producers of secondary electrons than atomic ions, but required a factor of two higher threshold velocity on the average than did atomic ions. The increased efficiency is examined and does not appear related, in the energy range examined, to complete decomposition of the molecule at the target. It is alternatively suggested that surface rather than interpenetration effects account for the difference in electron emission efficiency for molecules as compared to that for atoms. (auth)

332 GENERAL METHOD FOR COMPUTING THE STATISTICS OF CHARGE AMPLIFICATION IN PARTICLE AND

PHOTON DETECTORS USED FOR PULSE COUNTING. Dietz, L. A. (General Eelctric Co., Schenectady, N. Y.). J. Mass Spectrom. Ion Phys.; 5: No. 1-2, 11-19(Oct 1970).

A general method is given for computing output pulse-height distributions for a wide variety of multistage pulse-counting detectors used in mass spectrometry and in scintillation spectrometry. Calculations are simple, mathematically accurate, and require minimum computer time. Conditional probabilities and convolutions of generating functions are used to describe electron multiplication statistics at each stage of charge amplification. Among the detectors which can be analyzed are electron multipliers, photomultipliers, scintillation detectors, and the combination of an ion-converter dynode with a silicon semiconductor detector as it is used in diagnostic studies of secondary electron emission. Examples are given of theoretical fits to experimental data. (auth)

333 METHOD OF AMPLIFYING RADIATION DAMAGE IN A NUCLEAR DETECTOR. Goulin, Jean Paul Lucien (to Eastman Kodak Co.). British Patent 1,250,233. 20 Oct 1971. Priority date 5 Mar 1968, France.

An etching procedure for dielectric track detectors is described for amplifying the particle tracks. A basic aqueous solution containing a swelling agent for the sensitive material is used, and then another basic aqueous solution containing a solvent for the sensitive material is used. (W.H.K.)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 1157, 1231, and 1248.

334 (BLG-454) DEVELOPMENT AND IMPROVEMENT OF A NEW IN-PILE TECHNIQUE OF NEUTRON SPECTROMETRY BASED ON THE (n,p) COLLISIONS. de Leeuw-Gierts, G.; de Leeuw, S. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Apr 1971. 28p. (In French). Dep. NTIS (U. S. Sales Only).

A new proton recoil spectrometer, for in-core neutron spectrum measurements, is described. The spherical or cylindrical proportional counters, routinely used, cover an energy interval from a few keV up to about 1.5 MeV. The described spectrometer was conceived to determine the neutron spectrum above this energy limit. Attention was paid to keep the lower validity energy limit sufficiently small to obtain a large energy interval overlapping with the existing spectra. A hydrogeneous target and a silicon surface-barrier detector are the main parts of the spectrometer. A small proportional counter is inserted between the two to eliminate background pulses in the solid state detector, due to gamma radiation or competitive reactions with the silica of the detector. A filling of argon at low pressure completes the spectrometer. After the performance of the spectrometer was tested in the BR1 thermal graphite column by means of the $^{6}Li(n,\alpha)t$ reaction, a proton recoil spectrum was measured in the fast assembly mounted in BR1. The responses of both counters are analyzed in a bidimensional configuration by means of a two-parameter analyzer. (auth)

335 (FRNC-TH-67) GAMMA-RAY COMPTON SPECTROMETRY. THE SPECTROMETER. Meunier, Henri (Clermont-Ferrand Univ. (France). Faculte des Sciences). 1969. 46p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A Compton spectrometer intended for measuring the bremsstrahlung photon spectra emitted by electrons between 4 and 16 MeV passing through a thick target is presented. The reasons for the choice of a Compton spectrometer are examined and the nature of the Compton effect itself is recalled. The problems arising in the development of this apparatus are analyzed, especially that of electron detection using a Si(Li) semiconductor detector. The auxiliary electronic equipment is described. With the equipment available, a 20 keV resolution can be easily reached for 1 MeV electrons at a working temperature of −15°C. The results might be improved by using a higher degree of cooling. (France)

336 (JUL-767-ZE) DEFLECTION EQUIPMENT FOR THE PULSED OPERATION OF A LEAD SPECTROMETER. Eulenberg, Hannspeter; Manteuffel, Paul-Gerhard (Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Elektronik). Jun 1971. 49p. (In German). Dep. NTIS (U. S. Sales Only).

Operation of a lead spectrometer required short deuteron pulses which produced neutrons in a target. A special deflection apparatus was developed which yielded beam pulses of 20-μ sec pulse width at intervals from 3 to 27 msec. The pulses were guided across the target within 250 nsec. A special generator was developed for trapezoidal voltages with time-linear deflection characteristics. For this generator, mathematical as well as operational principles are described. The generator was operated from a 120-V source and required only 15 W. (H.B.G.)

337 (UJV-2510-FP) SET OF PROGRAMMES IN ALGOL FOR PROCESSING Ge(Li) SPECTRA. Kosina, Z. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov 1970. 15p. (In Czech). INIS.

Six programs are described for processing the gamma spectra measured with a semiconductor spectrometer. These are PRINTES (for writing down the spectra recorded on a punched tape), PLOTES (for plotting parts of the spectra in the square-root scale), SUMES (for determining the basic integral parameters of a selected part of the spectrum), FINDES (for determining the peaks and their basic parameters), FITES (for determining with more precision the positions, half-widths, and peak intensities, including calculation of statistical errors), and COMPES (for plotting the threoretical spectrum in a given interval and the experimental values from which it was derived). The programmes are written in ALGOL and represent a complete set. (INIS)

338 ^{235}U AND ^{239}Pu FISSION CROSS-SECTION MEASUREMENTS BY NEUTRON SLOWING-DOWN SPECTROMETER. Samsonov, A. E.; Stavisskii, Yu. Ya.; Tolstikov, V. A.; Chelnokov, V. B. At. Energ. (USSR); 31: No. 2, 103-6(Aug 1971). (In Russian).

^{235}U and ^{239}Pu fission cross-sections for 0.1 to 4.10^4 eV neutrons have been measured by the neutron slowing-down Pb spectrometer. Cross-sections have been normalized with the help of thermal fission cross-sections through additional measurements in the graphite prism placed side-by-side with the Pb prism. The ^{239}Pu, ^{235}U fission cross-section ratio was obtained from experimental results. The results are compared with the published data of other authors. (auth)

339 MEASUREMENT OF MEDIUM SPEED NEUTRON SPECTRA WITH BORON FILTERS. Nanjyo, Tsutomu (Kyoto Univ., Uji, Japan). Nippon Genshiryoku Gakkai Rochuseishi Kenkyu Senmon Iinkai Hokoku; No. 29, 1-16(Sep 1970). (In Japanese).

Medium-speed-neutron spectra in a reactor were observed with a BF_3 counter covered by boron filters of various absorption. A system measured was a cube with side length of 70 cm, which is composed of 1 cm thick graphite plates, boron carbide powder and aluminum. Atomic ratio per 1 cm^3 is $N_C : N_B : N_{Al} = 0.118\ N_0 : 0.00384\ N_0 : 0.00360\ N_0$, where N_0 is Avogadro's number. In this system, absorption of neutrons occurred in the range of 10 eV to 10 keV, and median energy was 200 eV. Detector was a BF_3 counter covered with ^{10}B filters. Six filters were used, and Σ_{a1} (1 eV) of the filters were 0.5, 1, 2, 3, 5 and 8. The neutron source employed was Am−Be. Detection efficiency was calculated for the counter with different filters. Correction for perturbation due to the detector was taken into account. Depression of neutron flux was caused by the boron filters. The lethargy spectrum $\phi(u)$ of the neutrons was obtained from the following equation: $R_i = \int_0^\infty Z_i(u)\phi du$ where $R_i(u)$ is counting rate obtained with i'th filter, $Z_i(u)$ the detection efficiency of the counter with i'th filter. Methods to solve this equation were investigated. Results of analyses by using an orthogonal polynomial method and a relaxation method were compared with results measured by time of flight method, and good agreement was obtained. This method of measurement will be applied to a monitor for spectrum index of the medium-speed neutrons in a reactor. (Japan)

340 HIGHLY STABILIZED TIME-MODE MOESSBAUER SPECTROMETER EMPLOYING CRYSTAL CONTROLLED DIGITAL CIRCUITS. Miyajima, Hideki (Tokyo Univ.). Jap. J. Appl. Phys.; 10: No. 10, 1405-9(Oct 1971).

A time mode Moessbauer spectrometer is constructed so as to get a well resolved spectrum. All the pulses used in the apparatus are generated by the digital circuits, which are triggered with the highly stable crystal oscillator. The operation is stable for a long run. Absorption peaks are well resolved and signal to noise ratio is improved. (auth)

High Energy Physics Instrumentation

Refer also to abstract 1075.

341 (N-71-22696) FOCUSED CHERENKOV RADIATION DETECTOR FOR PROTON BEAM ENERGY MEASUREMENTS. Beck, Sherwin M.; Powell, Clemans A. Jr. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Apr 1971. 10p. (NASA-TN-D-6194; L-7501). NTIS.

A focused Cherenkov radiation detection system has been developed and was used to measure the beam energy and energy

spread of the nominal 600-MeV proton beam. The inherent resolution of the detection system was 4.2% full width at half maximum for the measured proton beam energy of 557.6 + or −2.5 MeV. The energy spread of the proton beam was calculated to be 14 MeV full width at half maximum. (auth) (STAR)

342 TOTAL-REFLECTION-TYPE CHERENKOV COUNTER WITH HIGH EFFICIENCY. Fujii, Tadao (Tokyo Univ.); Iwata, Seigi; Homma, Saburo; Orito, Shuji. Jap. J. Appl. Phys.; 10: No. 10, 1446-9(Oct 1971).

A threshold-type Cherenkov counter which makes use of total reflection in a Lucite radiator, is constructed and tested using pion beams with various velocities. The detection efficiency of about 100% for relativistic particles ($\beta \approx 1$) is obtained. The detection threshold is found to be $\beta \approx 0.9$, whose value is expected from calculation assuming the index of refraction of Lucite to be 1.49. The counter is successfully used to separate $K^{\pm}$ mesons from pions in the momentum range below 700 MeV. (auth)

343 USE OF THE CAMAC SYSTEM FOR DATA ACQUISITION IN A PION–NUCLEON SCATTERING EXPERIMENT. Duclos, J. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Instrum. Nucl.; No. 42: 20-30(Jan 1971). (In French).

The CAMAC standard system was used as an intermediate unit between the detectors and the computer in scattering experiments. These experiments concern π^- and π^+ scattering by protons between 30 and 100 MeV; differential cross sections were measured, and low energy phase shifts and pion–nucleon scattering lengths were deduced from them. It was thus possible to define a certain number of acquisition units which may be adapted for use in other experiments. (France)

Radiation Dosimeters

344 (AED-C-21-8) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 21: Dosimetry. Becker, Klaus (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Jun 1971. 147p. (In English and German). Dep. NTIS (U. S. Sales Only).

This volume is concerned with chemical, photographic, and solid-state dosimetry. Literature up to mid-1970 is included. (R.W.R.)

345 DOSIMETRIC PROPERTIES OF BORON NITRIDE. Lubyanskii, G. A.; Styrov, V. V.; Sokolov, V. A. At. Energ. (USSR); 31: No. 2, 119-22(Aug 1971). (In Russian).

Thermoluminescent and dosimetric properties of boron nitride of hexagonal modification were studied after γ- and neutron irradiation and daylight illumination. Polycrystalline samples of BN, BN–MN, BN–Eu and BN–Sm were used. In the case of γ-irradiation the absorbed dose varied from 100 to 3.10^8 rad. The pure sample BN gave a thermoluminescence curve with two peaks 110 to 150 and 425 to 490°C. The accumulated lightsum of the first peak increased with the dose in a nonlinear fashion while in the second case it increased in a linear fashion up to 10^5 rad. The second peak shifted with a dose towards higher temperatures. Besides these peaks the sample BN–Mn gave one more "manganese" peak on the thermoluminescence curve at 250 to 270°C. The linearity of the accumulated lightsum with a dose remained in that peak up to 10^6 rad. For the samples BN–Eu and BN–Sm there were no activator peaks on the curve but a proper peak appeared at lower temperatures (at 60 to 70°). A dosimeter based on BN is tissue-equivalent. It may be used many times without any special intermediate treatment. The dosimeter is insensitive to interferences of tribo- and chemiluminescence type. However it is sensitive to daylight (the accumulated lightsum after 20 hours of illumination corresponds to γ-irradiation of 12 rad). Under irradiation of thermal neutrons the thermoluminescence curve obtained using BN has two peaks at 150 to 155 and 500 to 525°C. The thermoluminescence disappeared if doses were too high. The accumulated lightsum retained longer under neutron irradiation than under γ-irradiation. However the lightsum accumulated more effectively during γ-irradiation. BN may be used as a dosimeter in radiology and radiobiology. (auth)

346 APPARATUS AND METHODS FOR READING THERMOLUMINESCENT DOSIMETERS AND THE LIKE. Paynter, Donald A. (to EG and G, Inc.). U. S. Patent 3,600,583. 17 Aug 1971. Filed 24 Mar 1969.

A thermoluminescent-dosimeter reader in which dose measurements are based on the glow-curve peak is described. Measurements are made by comparing the output of a photomultiplier tube with the analog-converted state of a digital counter, the comparison being performed by alternately connecting a capacitor to the output of the digital-to-analog converter and to the signal from the photomultiplier, periodically, in order to produce error pulses that are amplified in an AC amplifier and that advance the counter when the sense of the error indicates that the signal is greater than the counter state. A two-speed clock controls the sampling frequency at which measurements are performed, so that the signal source is isolated from the measurement circuit most of the time, and the counter is advanced rapidly when the signal exceeds the counter state. Range-change circuitry inserts a shunting impedance into the input of the comparator when the counter fills to capacity, resets the counter, and actuates an indicator connected to the counter. (auth)

347 LiF SURFACE AND DEPTH DOSE MEASUREMENTS OF MEGAVOLTAGE PHOTON AND ELECTRON BEAMS. Kartha, M.; MacDonald, J. C. F. (London Clinic, Ont.). Acta Radiol., Ther., Phys., Biol.; 10: No. 2, 279-88(Apr 1971).

A simple dosimetric method using LiF TLD-100 phosphor in monocrystalline layers is presented. This technique is shown to be especially useful in the measurement of surface dose, absorbed dose in the region below the surface and electron depth dose in both homogeneous and heterogeneous absorbers. The measurement of a complete depth dose curve, including the surface dose and the dose in regions of sharp gradients is made possible by using stacks of the monocrystalline layers of TLD-100. (auth)

348 NEW CHEMICAL DOSIMETER FOR HIGH EXPOSURES TO IONIZING PARTICLES OR RADIATIONS. Bredoux, F. J. M. (to Societe Kodak-Pathe). French Patent 2,050,221. 2 Apr 1971. Filed 3 Jul 1969. (In French).

A new chemical dosimeter for determining high exposures to ionizing particles or radiations is presented. It consists of a supple support coated with a thin sensitive film containing a colorless tetrazolium salt. The action of radiation on this salt produces a formazan type color. (France)

349 PERSONAL PHOTOGRAPHIC DOSIMETERS. ISO R 1757 1971(E). International Organization for Standardization (1971). 9p. Available from American National Standards Institute, New York.

A standard prescribing requirements for the specification and testing of personal photographic dosimeters is presented. (W.H.K.)

350 GENERAL RECOMMENDATIONS FOR THE TESTING: CALIBRATION AND PROCESSING OF RADIATION MONITORING FILMS. BS 3890 1965. London; British Standards Institution (1965). 11p. Available from American National Standards Institute, New York.

A standard prescribing requirements for testing, calibrating, and processing radiation monitoring films is presented. (W.H.K.)

351 SPECIFICATION FOR FILM BADGES FOR PERSONNEL RADIATION MONITORING. BS 3664 1963. London; British Standards Institution (1963). 8p. Available from American National Standards Institute, New York.

A standard prescribing requirements for films badges for personnel monitoring is presented. (W.H.K.)

352 DIRECT READING POCKET TYPE ELECTROSCOPE EXPOSURE METERS. ISO R 1758 1971(E). International Organization for Standardization (1971). 3p. Available from American National Standards Institute, New York.

An ISO Recommendation prescribing requirements for direct reading pocket type exposure meters for x and/or gamma radiation from 30 keV to 3 MeV is presented. (W.H.K.)

353 INDIRECT READING CAPACITOR TYPE POCKET EXPOSURE METERS AND ACCESSORY ELECTROMETERS. ISO R 1759 1971(E). International Organization for Standardization (1971). 3p. Available from American National Standards Institute, New York.

An ISO Recommendation prescribing requirements for indirect reading capacitor type pocket exposure meters and associated electrometers for x and/or gamma radiation in the range from 30 keV to 3 MeV is presented. (W.H.K.)

354 SENSITIZATION OF THERMOLUMINESCENT LITHIUM-FLUORIDE γ-RAY DOSIMETER. Petralia, S. (Univ., Bologna). Lett. Nuovo Cim.; 2: No. 8, 413-17(21 Aug 1971).

Changes in the response of a LiF dosimeter as a result of pre-irradiation doses of ^{60}Co gamma rays are reported. For predoses below 30 kR the thermoluminescence (TL) per unit exposure dose (TL/R) increases with exposure between 3 and 40 kR; for predoses above 30 kR the TL/R decreases with exposure. The response of the phosphors to repeated irradiations without any annealing between irradiations was also studied. (R.W.R.)

355 RADIATION DOSIMETRY WITH ACETYLENE. McLaren, K. G. (Australian Atomic Energy Commission, Sutherland). Aust. J. Chem.: 24: No. 10, 2053-60(Oct 1971).

The suitability of acetylene as a gas-phase radiation dosimeter has been studied. Yields were obtained on an absolute basis, using ionization current dosimetry. Radiolysis of acetylene produces two products, benzene and polymer. The yield of benzene is dependent on dose, dose rate, presence of hydrogen or free radical scavengers, and temperature, and is of no value for estimating dose. For ^{60}Co γ irradiation at a dose rate of 4.1×10^{13} eV cm^{-3} $mmHg^{-1}$ hr^{-1} and acetylene pressure 500 mmHg (6.6×10^4 N m^{-2}) at 30°C, $G(-C_2H_2) = 82.1 + 0.5$. 1-MeV electron irradiation at a dose rate of 3.9×10^{16} eV cm^{-3} $mmHg^{-1}$ hr^{-1} gave a much lower yield, $G(-C_2H_2) = 55.0 \pm 1.9$, believed to be due to a dose rate effect. $G(-C_2H_2)$ increased by about 67% when the temperature was increased from 25°C to 125–250°C. Comparison with ethylene indicates the latter is the more useful dosimeter, as the yields do not vary significantly over a wide range of dose rates and temperatures. (auth) (Australia)

Radiometric Instruments

Refer also to abstracts 183, 186, 189, and 286.

356 (CSIRO-Trans-10538) PROBLEMS IN CALIBRATING THE NEUTRON PROBE: APPLICATIONS TO THE DETERMINATION OF ACTUAL EVAPORTRANSPIRATION OF CROPS. Damagnez, J. Translated by D. R. Eddy for Australian Atomic Energy Commission Research Establishments, Lucas Heights, from Soil-Moisture and Irrigation Studies, Vienna, 14–18 March 1966. 12p. (CONF-660338-1). Dep. NTIS (U. S. Sales Only).

An abstract of this article prepared from the original language appeared as NSA 22: 6667 (1968).

357 (IAEA-R-466-F) COMPARATIVE THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE NEUTRON MOISTURE GAUGE. PART OF A COORDINATED PROGRAMME OF RESEARCH IN NEUTRON MOISTURE GAUGES. Final Report, December 1, 1966–November 30, 1969. Oelgaard, P. L. (International Atomic Energy Agency, Vienna (Austria)). May 1970. 3p. INIS.

The following factors influencing subsurface type neutron moisture gages are reviewed: dry bulk density of the medium; chemical composition of the medium; geometry of the medium; and perturbation due to the insertion of the access tube. For the calculation of calibration curves used in connection with the subsurface type probe, a computer program, MOPS-III, was devised to consider the influence of the above-mentioned factors. In the investigation of surface type gages, a Monte Carlo study was undertaken to study the slowing-down and diffusion of neutrons in soils. A Monte Carlo computing code MCSS was devised to consider the slowing down of the neutrons in 12 different soil mixtures. The output of MCSS was given as the distribution of thermalization points or slowing-down maps of neutrons. These maps were subsequently used as input in the thermal code MCST which gave the thermal current in the detector region as output. The results were verified with experiments and also compared with the calculations obtained with Ølgaard's three-group diffusion model. (auth)

358 NEUTRON-RESONANCE APPARATUS WITH CENTRALLY LOCATED SOURCE. Bakhtin, B. S.; Filippov, E. M. At. Energ. (USSR): 31: No. 2, 161-3(Aug 1971). (In Russian).

A neutron resonance apparatus is described which was designed for boron determinations. The Pu–Be source yielded 4.3×10^6 n/sec, and was surrounded by a paraffin block for shielding. Tests were made with boron preparations containing 86 to 98% B, in order to determine the count rate as a function of B content. In addition, tests were made with one source located inside the casette, and with two sources in a moderator at the bottom of the casette. (K.S.W.)

359 NUCLEAR MASS FLOWMETER. Marshall, Thomas N. Jr. (to Administrator of the National Aeronautics and Space Administration). U. S. Patent 3,599,489. 17 Aug 1971. Filed 24 Mar 1970.

A flowmeter utilizing a beta source positioned upstream of a cylindrical capacitor formed by two separated concentric cylindrical sections is described. The concentric cylindrical sections form the capacitor electrodes, and they are a part of two concentric tubular members that are mounted in an outer housing that is adapted to be connected into a flow line so that fluid flows through both the inner and outer tubular members. The capacitor electrodes are insulated from the tubular members by means of dielectric ring members connected between them. Means are provided for detecting any potential difference between the two electrodes and for evacuating the space between the outer tubular member and the housing. (auth)

360 PULSE CHAMBER FOR ON-LINE CONTROL IN IRRADIATED FUEL REPROCESSING PLANTS. Edeline, J. C.; Guitton, J.; Pascal, A. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Instrum. Nucl.; No. 43, 20-5(Mar 1971). (In French).

Two types of nuclear pulse chambers are described: a chamber utilizing the detection of a particle flux emitted from the radioactive elements in the solution (α particle counting) and a chamber utilizing the detection of a particle flux emitted by auxiliary radioactive sources, i.e., the flux crossing the solution (γ absorption measurements). These pulse chambers are suitable for continuous use in the corrosive atmospheres of chemical plants. (auth)

361 IONIZATION DETECTION DEVICE USING A ^{63}Ni RADIOACTIVE SOURCE. Yauger, William L. Jr. (to Tracor, Inc.). U. S. Patent 3,601,609. 24 Aug 1971. Filed 19 Sep 1969.

An improved ionization detector capable of analyses at temperatures of 500°C or more for use with analysis instruments such as gas chromatographs that utilizes a radioactive source of nickel-63 is described. The system operates as an electron-capture detector for gas analysis. (auth)

362 IONISATION FIRE ALARM. Lampart, Thomas; Scheidweiler, Andreas; Kuhn (to Cerberus AG). British Patent 1,250,296. 20 Oct 1971. Priority date 19 May 1969, Switzerland.

A radioisotope source and ionization detector with a resistor in series are described for detecting smoke. (W.H.K.)

363 PASSIVE MOISTURE METER. Kastner, Jacob; Oltman, Billie G.; Feige, Yehuda (to United States Atomic Energy Commission). U. S. Patent 3,602,713. 31 Aug 1971. Filed 8 Jul 1970.

A passive moisture meter that measures the number of thermal neutrons present in a material as a result of natural radiation, such as cosmic rays, to determine the moisture content of the material is described. The thermal neutron flux in a control region of known moisture content is also measured to determine the magnitude of the high-energy neutron flux developed by the natural radiation. (auth)

364 TROUBLESHOOTING PROCESSES WITH RADIATION SURVEYS. McKinney, A. H. (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). Instrum. Technol.: 18: No. 8, 49-51 (Aug 1971).

A radioactive source and a detector can help to isolate and solve process problems. After describing various system configurations, some suggestions as to how radiation gages can be applied to the monitoring of normal and abnormal process conditions in pipes, storage tanks, and process vessels are made. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 411, 945, 1174, 1310, and 1442.

365 (AI-AEC-12818, pp 47-52) TRANSIT TIME FLOWMETER. Randall, R. L. (Atomics International, Canoga Park, Calif.). Jan–Mar 1969.

In AEC unclassified programs.

The development of a liquid metal flowmeter based on cross-correlation techniques is described. The technique involves the detection of small temperature variations (thermal eddies) at two points in the flow stream. The two signals are cross-correlated with a variable delay time. The delay time which gives maximum correlation is the transit time of the fluid between the sensors. (W.H.K.)

366 (KFK-1412) CAMAC SYSTEM CONTROLLER FOR A CALAS TERMINAL. Ottes, J. G. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jun 1971. 66p. (In German). Dep. NTIS (U. S. Sales Only).

A CAMAC System Controller capable of driving a full CAMAC Branch in conjunction with a CALAS Terminal is presented. Single operations, block transfers, module-to-module transfers, and autonomous transfers in both directions on a cycle-stealing basis can be handled by the Controller. The device can be adapted to other computers by changing some parts of its computer peripheral electronics. (auth)

367 (LA-4772) WIDE-BAND MAGNETIC-DISK RECORDING OF ANALOG FIELD DATA AND DIGITAL READOUT TO A REMOTE TERMINAL. Fullwood, R. R.; Veeser, L. R.; Marusak, A. L. (Los Alamos Scientific Lab., N. Mex.). Oct 1971. Contract W-7405-eng-36. 13p. Dep. NTIS.

An analog magnetic-disk recording system, complete with digital readout to a remote terminal, was used during a recent underground nuclear test at the Nevada Test Site. Dry-run and shot data were digitized and transmitted at 1000 baud by telephone lines to a remote terminal at Los Alamos, New Mexico. The terminal consisted of an on-line computer with a cathode-ray tube to display the data and an incremental magnetic tape to record the data in a form suitable for processing at the LASL Central Computing Facility. The bandwidth of the recording was dc to 3 MHz, and the signal-to-noise ratio was 200 to 1. Sixteen data channels and two clock tracks were used. (auth)

368 (LNF-71/10) DIGITAL-BASE MAGNETOMETRY WITH A HALL EFFECT PROBE. Balsamo, E. P.; Coli, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 11 Mar 1971. 27p. (In Italian). Dep. NTIS (U. S. Sales Only).

Circuits for digital-base magnetometry with a Hall-effect probe are described. Methods for the thermal stabilization of the probe, excitation of the probe with d-c circuits, and extraction of the field and reference signals with a-c currents are reported. (J.S.R.)

369 (NP-19000) INTEGRATING DIGITAL VOLTMETER AND ANALOG MULTIPLEXER IN CAMAC SYSTEM. Deimling, B.; Heep, W.; Klein, D.; Stiefel, W. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). May 1971. 37p. (In German). Dep. NTIS (U. S. Sales Only).

An analog multiplexer in connection with a unit to control an integrating digital voltmeter is developed. The control unit fits into the rules proposed for a general CAMAC analog-to-digital converter system. The features of the module and the reasons for using the flying capacitor measuring method are described. Finally, the accuracy of measurement and the methods to avoid errors are discussed. (auth)

370 (NP-19004) CAMAC: HIGH-VOLTAGE MODULE TYPE LEM-52/15.1. Heep, W.; Stiefel, W. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Apr 1971. 32p. (In German). Dep. NTIS (U. S. Sales Only).

A computer controlled high voltage power supply in the CAMAC system is described. The output voltages can be varied in steps of 0.5 V from 0 to 1000 V by means of stepping motors driving potentiometers with ten turns. The stepping motor control accepts the number of steps to be performed via the dataway and controls the execution. The control unit of the module contains two CAMAC units. A prototype of this module has been working for a few months. (auth)

371 (RD/B/N-2057) PASSIVE MAXIMUM TEMPERATURE MEASURING SYSTEM USING FUSIBLE ELEMENTS. Grindrod, A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug 1971. 8p. Dep. NTIS (U. S. Sales Only).

A maximum-temperature measuring system is described which is based on the well-defined fusion points of a range of pure metals, eutectics and other alloys. The system was designed to measure the maximum temperature in discrete increments where electrical data outlets are impracticable, such as the fuel element housing inside the storage magazine on charge/discharge machinery. (auth)

372 (TID-25816) TOPICAL REPORT ON LMFBR INSTRUMENTATION: STRAIN GAGES. PHASE I. HIGH-TEMPERATURE STRAIN GAGE DEVELOPMENT PROGRAM. TASK 1. LITERATURE AND FIELD SURVEY. Drennen, D. C.; Jackson, C. M.; Crites, Nelson; Sorenson, J. E. (Battelle Columbus Labs., Ohio). 13 Nov 1970. Contract N083-0004. 103p. Dep. NTIS.

For Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.

A literature and field survey of high-temperature strain gages for the LMFBR is reported. The identification and characteristics of alloys for high-temperature strain gages are reviewed; and high-temperature strain gages, lead wires, lead wire attachment, and insulation and bonding techniques are surveyed. 343 references. (W.H.K.)

373 ULTRASONIC DEVICE FOR DETECTING OR MEASURING THE LEVEL OF A LIQUID. Baron, Jean (to Commissariat a l'Energie Atomique). French Patent 2,052,163. 29 Mar 1971. Filed 24 Jul 1969. (In French).

An ultrasonic device for detecting or measuring the free surface level of a liquid such as Na is presented. A metallic stem with its lower part immersed in the liquid, is coupled to a transducer at its upper part. The ultrasound emission is instigated by a pulse generator associated with the transducer. A receiving unit associated with the transducer produces a signal depending on the amplitude of the echoes back to the transducer. (France)

374 DEVICE FOR NEUTRONOGRAPHY ANALYSIS. Chevalier, Philippe (to Laboratoires d'Electronique et de Physique Appliquee). French Patent 2,053,599. 5 Apr 1971. Filed 10 Jul 1969. (In French).

A neutronography device for analyzing low density substances is presented. It consists of an $n-\alpha$ convertor using the $^{6}Li(n,\alpha)^{3}H$ reaction or of an $n-\gamma$ convertor using the $^{157}Ga(n,\gamma)^{158}Gd$ reaction, and of a microchannel amplifier and a screen. (France)

375 SCREEN FOR NEUTRONOSCOPY AND NEUTRONOGRAPHY: PROCEDURE FOR FABRICATING THIS SCREEN AND A DEVICE UTILIZING THIS SCREEN. Barbalat, Rene; Leger, Pierre (to Commissariat a l'Energie Atomique). French Patent 2,041,456. 18 Jan 1971. Filed 24 Apr 1969. (In French).

The screen is extremely thin and has a high luminous yield. Scattering and refraction are minimized. The low remanence of this screen allows moving and stationary objects to be equally well observed. Activation of this screen is practically negligible thus permitting observation over a long period. The screen is characterized by its uniform composition which consists of essentially two substances: a substance possessing an elevated neutron capture cross section and emitting alpha particles when neutron irradiated, and a luminescent substance rendering the screen thickness to be sensibly of the same depth as the path of the α particles in the screen. (France)

376 APPARATUS FOR MEASURING THE CONTENT OF FISSILE SUBSTANCE OF FUEL ELEMENTS OR THE BURN-UP OF FUEL ELEMENTS, OF A NUCLEAR REACTOR. Dierckx, Ronald; Hage, Walter; Kumpf, Siegfried; Raievski, Victor (to EURATOM). British Patent 1,248,030. 29 Sep 1971. Priority date 28 Jul 1969, Germany.

A system for measuring the fissile content or burnup of irradiated reactor fuel elements is described. The apparatus consists of a conveyer system which conveys the fuel elements through a decay zone, then through a neutron irradiation station, and then to a neutron measuring station. (W.H.K.)

377 NEUTRONOGRAPHY EQUIPMENT USING A NEUTRON BEAM EXTRACTED FROM A NUCLEAR REACTOR. Farny, Gerard; Laporte, Andre (to Commissariat a l'Energie Atomique). French Patent 2,044,547. 8 Feb 1971. Filed 23 May 1969. (In French).

Equipment for neutronography and neutronoscopy using a neutron beam extracted from a nuclear reactor is presented. It is of the type with a neutron collimator near the neutron source. It consists of a cooled single Bi crystal located behind the collimator and centered on the axis of this collimator, a straight channel with a cross section greater than that of the single crystal passing through a dense medium, a sealing window with a metal plug connecting the collimator and the channel, and a neutronography unit. (France)

378 GA-6, A NEW RESIDUAL GAS ANALYZER WITH MAGNETIC SECTOR (MASSES FROM 2 TO 2000). Leger, P. (Societe Veeco, Versailles, France). Vide; 26: No. 151, 19-21(Jan 1971). (In French).

The GA-6 is a new residual gas analyzer with a mass range of 2 to 500, 12 to 1000 and 25 to 2000. The resolving power is variable up to 300. The partial pressure sensitivity is in the 10^{-24} torr range with N_2. The GA-6 can be used for quantitative residual gas analyses, chemical analyses and isotopic studies (measurement of the H_2/D_2 isotope ratio); it can be fitted with a double slit collector. (France)

379 DEVICES FOR LOCATING LEAKS IN HEAVY-WATER HEAT-TRANSFER SYSTEMS. Ont. Hydro Res. Quart.; 21: No. 3, 21(1969).

The "cold finger" and "bubbling liquids" methods are described briefly. The first method depends on condensation of heavy water steam on a bright cooled metallic surface which is rotated slowly near the suspected leak. The mist is viewed under a miniature spotlamp. The second method employs a liquid with a boiling point of at least 180°C. Bubbles appear at the site of the leak. Escape rates as small as one gram per hour can be observed. (Canada)

380 MAGNET AND CONTROLLER FOR A FAST SCANNING MASS SPECTROMETER. Haertel, G.; Morrison, J. D.; Smith, J. F. (La Trobe Univ., Victoria, Australia). J. Mass Spectrom. Ion Phys.; 5: No. 3-4, 215-22(Nov 1970).

In a mass spectrometer intended for both GLC–mass spectrometer–computer combination and for dual beam isotope ratio measurements, the magnet has special requirements. In the first case short scan and reset times are necessary; in the second, the requirement is for good stability. A brief description of such a magnet and its associated control and flux density measuring circuitry, is given. Reset times of less than 1 second are achieved in a very simple manner. (auth)

381 URANIUM ACTIVATED FLUORESCENT MATERIALS. Natansohn, Samuel (to GTE Labs. Inc.). British Patent 1,248,968. 6 Oct 1971. Priority date 6 Dec 1967, United States.

A phosphor which emits green luminescence when exposed to uv, electron, or x radiation has the composition $(Li_2O)_x(MgO)_y(AO_2)_z(BO_3)_z(C_2O_5)_{1-z}$: wU, where A is Ti, Zr, Hf, Ge, Sn, or Pb; B is Mo, Te, or W; C is Nb, Sb, or Ta; $x = 2$ to 6; $x + y = 8$; $0 < z \leq 1$; and $w = 0.005$ to 0.10 (optimum $w = 0.02$). Several examples of the preparation of such phosphors and the optimum firing temperatures are given. (D.L.C.)

382 MASS SPECTROMETER WITH ION SEPARATION BY TIME OF FLIGHT IN A RETARDING ELECTRIC FIELD. Bronshtein, A. M.; Rafal'son, A. E. (Special Analytical Instrumentation Design Office, Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 624-5(Oct 1971).
Translated from Zh. Tekh. Fiz.; 41: No. 4, 797-9(Apr 1971).

A new mass spectrometer is described which uses ion separation by time of flight in a gap with a retarding electric field. This configuration can give higher resolution than ion separation in a field-free gap. The work is of interest to those concerned with mass-spectrometer research. (auth)

383 ION-OPTICAL CHARACTERISTICS OF A CYLINDRICAL-MIRROR ELECTROSTATIC ENERGY ANALYZER. Zashkvara, V. V. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 651-2(Oct 1971).
Translated from Zh. Tekh. Fiz.; 41: No. 4, 829-30(Apr 1971).

The results of calculations of the ion-optical characteristics of a cylindrical mirror operating as a second-order angular focusing device of the annulus-axis type are presented. (W.H.K.)

384 ELECTRICAL SENSING DEVICE FOR MEASUREMENT OF LIQUID METAL LEVELS. (to Instytut Badan Jadrowych). British Patent 1,251,347. 27 Oct 1971. Priority date 2 Dec 1967, Poland.

Two sets of coils connected to a bridge circuit with an ac power supply are described for measuring the levels of liquid metals. (W.H.K.)

Radiation Effects on Instruments and Instrument Components

385 (FOA-4-4454) IRRADIATION OF p-n JUNCTIONS WITH 600 keV X-RAY FLASH. Lindstroem, L.; Sigfridsson, B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Feb 1971. 50p. (In Swedish). INIS.

Experiments with short pulses of x-radiation on p–n junctions are described. Radiation-induced currents in reversed biased p–n junctions were studied particularly. Comparison is made with a theory describing the decay of the diffusion current. In most cases, the agreement is good. Conventional measurements for determination of the minority carrier lifetime and the width of the depletion layer are described. A development of the so-called light-spot method shows that this method is sometimes suited for measurements of variations in the width of the depletion layer. Finally, the number of generated electron–hole pairs in Si per unit dose was determined. (Sweden)

386 (LYCEN-7127) EXPERIMENTAL BEHAVIOR OF BIPOLAR TRANSISTORS SUBJECTED TO INTENSE PULSES OF IONIZING RADIATION AND THE RESULTING ANOMALIES. Genre, Roger (Lyon Univ. (France). Institut de Physique Nucleaire). Jun 1971. 89p. (In French). Dep. NTIS (U. S. Sales Only).
Thesis. Submitted to Lyon Univ. (France).

Photocurrents, and in particular anomalous photocurrents, induced in semiconductor devices by radiation pulses were studied in view of determining a one-to-one relation between the phenomena observed and a physical process correlated to the semiconductor structure. The general phenomena are reviewed. It is assumed that anomalous photocurrents are always associated with negative resistance regions in the I(V) characteristics of the semiconductor. This hypothesis was verified experimentally. Three mechanisms by which anomalous photocurrents are generated are considered: emitter-base junction breakdown, avalanche injection, and secondary thermal breakdown. A method of simulating gamma pulses using 1 MeV protons pulses is described. (France)

387 (N-71-32698) RADIATION EFFECTS DESIGN HANDBOOK. SECTION 6. SOLID-STATE PHOTODEVICES. Drennan, J. E. (Battelle Memorial Inst., Columbus, Ohio. Radiation Effects Information Center). Aug 1971. Contract NASw-1568. 32p. (NASA-CR-1872). NTIS.
This document summarizes information concerning the effects of radiation on solid-state photodevices, especially solar cells. The forms of radiation include neutrons, protons, electrons, and electromagnetic. Several curves are presented. (auth) (STAR)

388 IONIZATION RADIATION EFFECTS IN INSULATORS AND INSULATING PARTS. Van Lint, Victor A. J.; Harrity, John W. (Gulf Radiation Tech., Gulf Energy, and Environmental Systems, Inc., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Elec. Insul.; EI-6: No. 3, 111-13(Sep 1971).

The effects of ionizing radiation on insulator parts are discussed as being the results of four associated phenomena: conduction, charge transfer, space charge buildup, and air ionization. Techniques for estimating these effects under some circumstances of interest are described. (auth)

389 SMOKE DETECTING CHAMBER CONSTRUCTION. Scheidweiler, Andreas; Kuhn, Max; Muller, Peter (to Cerberus AG). British Patent 1,250,297. 20 Oct 1971. Priority date 19 May 1969, Switzerland.

A radiometric smoke detector composed of a radiation source and ionization detector is described. A sealed reference ionization chamber is included in the circuit. (W.H.K.)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Immunology

Refer also to abstracts 411 and 413.

390 (AI-AEC-12818, pp 41-6) RADIATION CHEMISTRY OF CHROMOSOMES. (Atomics International, Canoga Park, Calif.). Jan-Mar 1969.

In AEC unclassified programs.

Research developments in radiation chemistry of chromosomes and their main constituents, such as nucleic acids and proteins, are reported. The studies include: radicals formed by electron attachment to amino acids; structure and reactions of purine and pyrimidine anions; reactions of hydroxyl radicals; and effects of hydrogen atoms and γ radiation on polyalanine. (P.C.H.)

391 (AI-AEC-12887, pp 37-42) RADIATION CHEMISTRY OF CHROMOSOMES. (Atomics International, Canoga Park, Calif.). Jul-Sep 1969.

In AEC unclassified programs.

Research developments in studies on the radiation chemistry of chromosomes and their main constituents, nucleic acids and proteins, are reported. Topics discussed include: reaction of electrons with dipeptides; reactions of electrons with polypeptides; reactions of electrons with acetyl amino acids and acetyl dipeptides; reactions of electrons with esterified peptides; and radiolysis of frozen aqueous solutions of cell nuclei at 77°K. (P.C.H.)

Ecology

Refer also to abstracts 156, 1545, and 1595.

Genetics and Cytogenetics

392 GENETIC STUDIES IN FIVE RADIATION-INDUCED MUTANTS IN JUTE. Bose, S. (Univ. of Calcutta). Curr. Sci. (India); 40: No. 18, 500-1(20 Sep 1971).

Five radioinduced mutants were used in crossing experiments and the segregation behavior of the resulting hybrids was studied. It was revealed that all five mutants were recessive. Joint segregation of various mutants showed independent assortment into four types with a 9:3:3:1 ratio indicating no linkage. Other segregation and backcross experiments are discussed. (H.L.W.)

Health Physics and Safety

Refer also to abstract 653.

Radioactive Contamination and Decontamination

Refer also to abstract 196.

393 DOSIMETRIC CONTROL OF ^{137}Cs IN THE AGRICULTURAL PRODUCT GRAINS OF THE CZECH SSR DURING 1967 TO 1969. Benes, Jaroslav; Matouskova, Jirina; Panyr, Milos. Jad. Energ.; 17: No. 8, 275-8(Aug 1971). (In Czech).

Cesium-137 contamination of cereals and fruits of siliquous plants within the Czech SSR was monitored for the years 1967 to 1969. In this period the abrupt fall in ^{137}Cs content began to decelerate in comparison to the preceding years. In the ^{137}Cs-uptake mechanism in the plant the absorption by the below-ground portions of the plant predominated over the uptake of the radioisotope by the root system from the subterranean reservoir. (tr-auth)

Dosimetry and Monitoring

Refer also to abstracts 181 and 316.

394 USE OF RaB AND RaC BETA COUNTING FOR DETERMINING THE POTENTIAL OF ALPHA-RAY ENERGY RADON DAUGHTERS IN MINE AIR. Domanski, J.; Olichwier-Holwek, J. Nukleonika; 14: No. 3-4, 181-90(1971). (In Russian).

A method is presented for estimating the potential of alpha energy of radon daughters occurring in the air of mines. The procedure is based on filtration of a given air volume through a paper filter and subsequent measurement of the beta activity of deposited RaB and RaC, 1 or 40 minutes after termination of the filtration. The potential of alpha energy per unit volume of air may be estimated from the total beta count rate with an accuracy similar to that obtainable from alpha counting of RaA and RaC'. (auth)

Radiation Protection

395 SPECIFICATION FOR SYMBOL FOR IONIZING RADIATION. British Standard 3510 1968. London; British Standards Institution (1968). 6p. Available from American National Standards Institute, New York.

British standards for a basic symbol to denote the actual or potential presence of ionizing radiations are presented. For the purpose of this standard ionizing radiations include α and β particles, high-speed electrons, γ and x rays, protons, and other ionizing particles. (C.H.)

Medicine

Protective Substances

396 CYTOTOXIC EFFECTS OF SCIRPENE COMPOUNDS, FUSARENON-X PRODUCED BY FUSARIUM NIVALE, DIHYDRONIVALENOL, AND DIHYDROFUSARENON-X, ON HeLa CELLS. Ohtsubo, Kohichiro; Saito, Mamrou (Tokyo Univ.). Jap. J. Med. Sci. Biol.; 23: No. 4, 217-25(Aug 1970).

Three toxic substances related to nivalenol were tested for their growth inhibiting activity and suppressive effects on DNA, RNA, and protein syntheses of HeLa S3 cells in comparison with those of nivalenol. Fusarenon-X, isolated from culture filtrate of Fusarium nivale, showed a complete inhibition of growth of HeLa S3 cells at a concentration of 0.5 μg/ml. The ED_{50} for ^{3}H-thymidine incorporation into DNA and ^{3}H-leucine into protein were 0.1 and 0.13 μg/ml (2.8 and 3.6×10^{-7} M), respectively, thus indicating about a four times potent activity as compared with that of nivalenol. No inhibition of ^{3}H-uridine incorporation into RNA occurred. Dihydronivalenol and dihydrofusarenon-X, -9-ene reduced substances of nivalenol and fusarenon-X, respectively, showed similar toxic effects on HeLa cells but with a six to ten times lower toxicity. The complete growth inhibition doses for the cells by both samples were around 3.0 μg/ml and the ED_{50} for ^{3}H-thymidine and leucine incorporation were around 2.0 μg/ml. ^{3}H-uridine incorporation was not remarkably inhibited. Biological effects of some other Fusaria metabolites having closely related chemical structures are discussed in association with nivalenol and fusarenon-X. (auth)

397 EFFECT OF BIS(-3-HYDROXYPROPYL) TRISULFIDE ON THE PERIPHERAL BLOOD OF RATS IRRADIATED WITH HIGH DOSES OF X-RAYS. Zebro, Tadeusz; Kowalczykowa, Janina; Mirek, Teresa; (and others). Pol. Med. J.; 10: No. 2, 517-25(1971).

The influence of bis(-3-hydroxypropyl) trisulfide in rats subjected to whole-body irradiation with 420 R of x rays was studied. Experiments were carried out with 4 groups of hooded rats: a group irradiated, but not treated with the trisulfide, a group irradiated 8 minutes after receiving a dose of 50 mg/kg body weight of the trisulfide, and a third group treated with the compound but not irradiated. The peripheral blood of the rats was examined on the day preceding irradiation and in the course of 98 days after irradiation. The blood from a control group of rats was also studied. Red and white blood cells and reticulocytes were counted, the percentage of white blood cells was determined, and hematocrit and hemoglobin were assayed. Electrophoresis of serum proteins was also performed. Administration of the trisulfide before irradiation caused a rapid increase in the number of lymphocytes in the peripheral blood of rats, as compared with animals irradiated only, but had no significant effect on normalization of the other morphologic blood elements. (auth)

398 COCARCINOGENESIS: THE INTERACTION OF CHEMICAL AND PHYSICAL AGENTS. Vogel, Howard H. Jr.; Zaldivar, Robert (Univ. of Tenn., Memphis). Radiat. Res.; 47: No. 3, 644-59(Sep 1971).

The physical agent used in this study was fission neutrons (300 to 360 rads). The chemical carcinogen was N,N'-2,7-fluoromylene-bisacetamide, injected intraperitoneally for 23 weeks, total dose: 414 mg. The aim of this experiment was to test the effects of the physical agent and the chemical agent as possible cocarcinogens in male Buffalo rats, 6 to 10 weeks old. Only one case of an intestinal neoplasm was found in 65 control rats at autopsy (1.5%). There were no observed tumors of stomach or liver among these controls. In 156 experimental rats autopsied with histopathological diagnosis, 15 stomach cancers (9.6%), 28 intestinal cancers (18.0%), and 37 hepatic cancers (23.7%) were diagnosed. The physical agent appeared to promote neoplasms of the GI tract. The chemical agent induced both intestinal and hepatic tumors. A synergistic action on the production of liver and gastric carcinoma was apparent when the two agents were combined. In contrast, when the two agents were combined, no additivity nor potentiation was found in relation to tumors of the intestine. The neutron-irradiated rats also showed many cancers of the adrenal and mammary glands as late effects. Correlation between length of life in rats and various cancer frequencies was examined. (auth)

399 RADIOSENSITIZATION OF MAMMALIAN CELLS BY p-NITROACETOPHENONE. I. CHARACTERIZATION IN ASYNCHRONOUS AND SYNCHRONOUS POPULATIONS. Chapman, J. D.; Webb, R. G.; Borsa, J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Biol.; 19: No. 6, 561-73(1971).

The effectiveness of p-nitroacetophenone (PNAP) as a sensitizing agent to x rays was measured in asynchronous and synchronous populations of Chinese hamster cells. PNAP was found to sensitize hypoxic cells selectively (those equilibrated with an environment of 96% N_2 + 4% CO_2 containing less than 2 ppM O_2) with a maximum dose-modifying factor (DMF) of about 1.50 at concentrations of 400 μM and greater in complete medium. In a parallel radiation scheme, the DMF for cells saturated with air was consistently between 2.75 and 3.05. In synchronously-growing Chinese hamster cells, the cyclic variation in surviving fraction measured for cells in air experiencing a radiation dose of 1055 rads could be reproduced for cells irradiated in hypoxic conditions with 2840 rads. It is concluded that O_2 sensitizes Chinese hamster cells in a dose-modifying fashion, irrespective of position in the cell-cycle. Hypoxic synchronized cells irradiated in the presence of PNAP with 1980 rads are also sensitized in all phases of the cell-cycle, PNAP being slightly more effective for S-phase cells. This differential sensitization is expressed by a two-fold reduction of the cyclic variation in cell sensitivity compared with that of cells irradiated in air or N_2. The sensitizing ability of 500 μM PNAP was also determined for air-saturated and hypoxic mouse L-cells, and a selective hypoxic sensitization of about 40% of that of oxygen was measured. (auth)

400 ELECTRON AFFINIC SENSITIZATION. PART II. PARA-NITROACETOPHENONE: A RADIOSENSITIZER FOR ANOXIC BACTERIAL AND MAMMALIAN CELLS. Adams, G. E.; Asquith, J. C.; Dewey, D. L.; (and others) (Mount Vernon Hospital, Northwood, Eng.). Int. J. Radiat. Biol.; 19: No. 6, 575-85 (1971).

The radiosensitizing properties of the highly electron-affinic nitroketone, p-nitroacetophenone (PNAP) were investigated in resistant and sensitive bacteria, fern spores, mammalian cells in tissue culture, and in suspensions of bacteriophage. Radiosensitization occurs in anoxic suspensions of Serratia marcescens, Micrococcus radiodurans and in anoxic preparations of Chinese hamster cells line V79-379A. The sensitization of the mammalian cells (enhancement ratio 1.7 for 0.4 mM PNAP) is not inhibited in the presence of serum protein. No sensitization was observed for the spore of the fern Osmunda regalis. PNAP resembles oxygen in conferring some radioprotection on suspensions of bacteriophage T_7 irradiated in broth. (auth) (UK)

Radiation Sickness and Injuries

401 TREATMENT OF RADIOEPITHELITIS WITH METHACIL AND MERADINE. Manyuta, A. I. (Odessa Medical Inst.). Med. Radiol.; 16: No. 8, 32-6(Aug 1971). (In Russian).

One hundred and fifty patients with cancer of the larynx and pharynx who were subjected to telegammatherapy were examined. In 76 patients, radiation treatment was complicated by focal radioepithelitis and in 30 by diffuse epithelitis. In 44 patients, hyperemia of the mucous membrane appeared. Radioepithelitis was treated with methacil in the form of inhalations and insufflations, and meradine and streptomycin in the form of inhalations. Good results were achieved with methacil and meradine. (auth)

Radiodiagnosis

Refer also to abstract 327.

402 PULMONARY EMBOLISM PRESENTING AS ASTHMA BRONCHIALE AND ITS TREATMENT WITH HEPARIN. Bartzokas, St. K.; Boultepsis, Sp. (Univ., Athens). Therapiewoche; 21: No. 31, 2222-4(4 Aug 1971). (In German).

The history of one patient who displayed the clinical picture of asthma bronchiale with severe wheezing is reported. Scintigraphy of the lungs showed decreased uptake of radioactivity at the base of the left lung and inhomogenous distribution of radioactive material in the center of the right lung. Conventional asthma therapy was unsuccessful, whereas heparin treatment yielded good results. It was concluded that scintigraphy represents a new and important tool for differentiating lung embolism and asthma bronchiale. (H.B.G.)

Radiotherapy

Refer also to abstracts 406 and 407.

403 EFFECT OF GAMMA RAYS OF ^{60}Co ON THE ISCHEMIC BLADDER WALL. ANIMAL EXPERIMENT STUDY. Hienzsch, E.; Arndt, J.; Albert, L.; Walmuth, L.; Kriester, A. (Friedrich-Schiller Univ., Jena, Ger.). Z. Urol. Nephrol.; 63: No. 11, 847-55(Nov 1970). (In German).

Studies were made on a combination of treatments for malignant bladder tumors. The urinary bladder of rabbits showed significantly enhanced histopathological alterations when ^{60}Co γ radiation was applied to the tumor free bladder wall with impaired vascular supply. Inflammatory as well as degenerative processes were predominant. The relationship between subsidence of the reactions and time was also studied. Results outlining the best time interval for commencing radiotherapy following surgical procedures with ligation of vessels such as the hypogastric arteries are given. (tr-auth)

404 X-RAY INDUCED INFLAMMATION. PRIMARY CONSIDERATION IN THE TREATMENT OF POSTOPERATIVE INFLAMMATORY STENOSIS FOLLOWING GASTROENTEROSTOMIES OF THE INTESTINAL AND BILE DUCT SECTIONS. Willmen, H. R.; Busch, H.; Buergel, Ch. Zentralbl. Chir.; 96: No. 2, 53-8(9 Jan 1971). (In German).

In spite of flawless surgical techniques, postoperative inflammatory stenosis occasionally occurs in gastroentero-anastomosis as well as in the small intestine and bile duct. Since reoperation involves high mortality, patients who cannot be treated effectively with drugs are given x-ray therapy. Three case histories are presented. Total doses between 165 and 200 R were given in nine to twelve single fractions. Two patients showed excellent response, while the third failed to respond because of too narrow an anastomosis. (H.B.G.)

405 DIRECT VIEW IRRADIATION BY BETATRON ELECTRON BEAM FOR BLADDER CARCINOMA. Sugimura, Katsuharu (Mie-Ken Kosei Nogyo Kyodo Kumiai Rengokai Chuo Sogo Hospital, Matsusaka, Japan). Rinsho Hinyokika; 24: No. 8, 727-32(Aug 1970). (In Japanese).

External irradiation, even using supervoltage radiation, is not satisfactory for the treatment of bladder carcinomas. This is due to the fact that the tumor can not be fixed in the hollow organ, making uniform radiation distribution virtually impossible and leading to severe local side effects. Nine patients with bladder tumors were treated by betatron electron beam therapy through the surgical opening made for suprapubic cystostomy. Doses of the 6 and 12 MeV electrons were from 2500 to 3000 R and the field size was 3 to 4 cm. The tumors were irradiated following electrocoagulation. Partial cystectomy and ureteroneocystostomy were performed when necessary and antitumor agents were used in conjunction with the radiotherapy in three cases. Irradiation was not difficult in cases with bladder neck tumors where partial resection was difficult. One of the patients died of col pulmonare, but the other eight are in good condition without recurrence or metastasis after 4 to 28 months. This method of treatment is simple and effective with no general or local side effects. (auth)

Blast and Thermal Effects

Refer also to abstracts 399 and 400.

Radiation Effects on Animals

Vertebrates

Refer also to abstracts 397, 398, and 403.

Man

Refer also to abstract 401.

406 REACTIONS AND COMPLICATIONS FOLLOWING RADIOTHERAPY OF GYNECOLOGIC CANCERS. Merz, W. R.; Alessandrini, G.; Curchod, A.; Stauffer, R. Rev. Med. Suisse Romande; 89: 449-60(May 1969). (In French).

With respect to reactions and complications following radiotherapy of gynecologic cancers, localized and systemic processes are discussed. Under local reactions and complications the following topics are discussed: inflammatory infiltration, fibrosis, fistula formation, and spontaneous fractures. Intensity of complications depends on individual tolerance, tissue condition, spread of the cancer, radiation technique, and total dose. Emphasized are infections, lesions of bladder and rectum, lesions of the vagina, and spontaneous fractures. Under systemic reactions disturbances of metabolism and electrolyte equilibrium, imbalance of the endocrinal system, and toxic effects of protein degradation products are discussed. In addition to early radioinduced symptomatology, the later occurring bone marrow changes are discussed. (H.B.G.)

407 INCIDENCE OF LATE LEUKEMIA IN IRRADIATED CANCER PATIENTS. Simon, S. (Univ., Brussels). J. Belge Radiol.; 54: No. 1, 119-24(Jan-Feb 1971). (In French).

A five-year survey is given of patients irradiated at the cancer center at Brussels University. Patients were studied who received 1500 to 3000 rad to the trunk, and were compared with others who received 5 to 30 rad to the trunk. None of the patients, who received less than 20 rad to the trunk, developed late leukemia. At higher doses, however, incidence of leukemia was noticeable. In comparison with population statistics, increased incidence of leukemia in cancer patients was significant on the 0.001 level. It was concluded that radioinduced leukemia possesses a threshold dose, beyond which incidences increase with dose. (H.B.G.)

408 DEISTVIE POLONIYA-210 NA ORGANIZM. (Effect of ^{210}Po on the organism). Moroz, B. B.; Parfenov, Yu. D. Moscow; Atomizdat (1971). 160p.

This monograph focuses attention on the highly toxic radioisotope polonium-210, its intake routes into man, its distribution, and removal. The toxicology of ^{210}Po is considered, its relative biological effectiveness, and late effects. The clinical aspects are described, such as blood changes, hemorrhagic syndrome, and pathology of the liver and kidneys, and changes in the nervous and endocrine systems. Functional changes of the adrenal gland cortex, general infection, immunity, and chronic radiation sickness are other topics of importance. 417 references. (K.S.W.)

Radiation Effects on Plants

Refer also to abstract 400.

Radiation Effects on Microorganisms

Refer also to abstract 400.

Radiosterilization and Radiopreservation

409 STUDIES ON THE ECOLOGY OF INSECTS STERILIZED ARTIFICIALLY (GAMMA RADIATION). 5. DEVELOPMENT AND REPRODUCTION OF THE PROGENY FROM IRRADIATED PUPAE, SPODOPTERA LITTRALIS BOISD., BY GAMMA RADIATION. Kiyoku, Masao; Tsukuda, Ritsuko (Okayama Univ., Japan). Okayama Daigaku Nogakubu Gakujutsu Hokoku; No. 36, 19-26(Oct 1970). (In Japanese).

Seven nine-day-old male pupae were irradiated with 2 kR or 16 kR of gamma radiation (^{137}Cs). Adult males that emerged were crossed with unirradiated females in single paired matings (T ♂ × U♀). F_1 and F_2 progeny from this mating were reared successively. The life history of these progeny was observed and the following conclusions were made. Developmental time of the F_1 larvae, especially of the F_1 female, was longer than that of unirradiated individuals. Duration of pupal periods seemed to decrease for females, but the difference was not significant. Percentages of pupation and emergence of the F_1 progeny decreased considerably as compared with normal individuals. The reduction of percentages was dose dependent. At 16 kR, the percentage of emergence in the F_1 adult females decreased more than that in the F_1 adult males. Extreme sex ratio distortion was observed (0.353). Body weight of the F_1 pupae was lighter than that of the controls. Mating frequency of the F_1 progeny was somewhat higher than that of normal ones. The number of eggs laid by F_1 ♂ × F_1 ♀ was nearly as great as that of the control pair. When the P male received 2 kR, the hatchability (%) of eggs by F_1 ♂ × F_1 ♀ was high. When the P male received 16 kR, the F_1 progeny were nearly sterile. Hatching percentages for eggs from unirradiated females crossed with F_1 male progeny of the P males that received 16 kR were frequently high, but eggs of the F_1 females crossed with unirradiated males always showed an extremely low hatachability. Many of the F_2 larvae and pupae obtained from F_1 ♂ × F_1 ♀, U ♂ × F_1 ♀, or F_1 ♂ × U ♀ died during their growing period, and the survival to F_2 adults was extremely low. Resultant F_2 adults did not mate as well as normal ones. F_2 females mated rarely, had poor production, and laid few sterile eggs. (auth)

410 EFFECTS OF GAMMA RADIATION ON SOIL AND DIPHENAMID. Horowitz, M.; Hulin, Nira (Volcani Inst., Haifa, Israel). Weed Sci.; 19: No. 3, 294-6(May 1971).

Gamma radiation of 3 megarads (Mrad) achieved complete sterilization in Newe Ya'ar clay soil, without affecting subsequent growth of oats (Avena sativa L., var. Mulga) in the irradiated soil. N,N-dimethyl-2,2-diphenylacetamide (diphenamid) in aqueous solution or mixed within Newe Ya'ar soil was detoxified by irradiation with 3 Mrad. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

411 (AI-AEC-12818) AEC UNCLASSIFIED PROGRAMS. Quarterly Technical Progress Report, January–March 1969. (Atomics International, Canoga Park, Calif.). Contract AT-(04-3)-701. 52p. Dep. NTIS.

Eight sections are included; separate abstracts were prepared for seven. The remaining section is a brief description of the HNPF retirement project. (P.C.H.)

For abstracts of individual papers see: 73, 104, 365, 390, 565, 795, and 1586.

412 (AI-AEC-12860) AEC UNCLASSIFIED PROGRAMS. Annual Technical Progress Report, GFY 1969. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. 68p. Dep. NTIS.

Six sections are included; separate abstracts were prepared for 5. The remaining project is on HPNF retirement. (P.C.H.)

For abstracts of individual papers see: 74, 105, 566, 796, and 1587.

413 (AI-AEC-12887) AEC UNCLASSIFIED PROGRAMS. Quarterly Technical Progress Report, July–September 1969. (Atomics International, Canoga Park, Calif.). Contract AT-(04-3)-701. 42p. Dep. NTIS.

Six sections are included; separate abstracts were prepared for four. The remaining two sections contain brief information on the two projects on HNPF retirement and high-temperature chemistry. (P.C.H.)

For abstracts of individual papers see: 391, 567, 797, and 1588.

414 (AI-AEC-13007) FUELS, MATERIALS, AND COOLANT CHEMISTRY PROGRAMS. Annual Technical Progress Report, GFY 1971. (Atomics International, Canoga Park, Calif.). 15 Aug 1971. Contract AT(04-3)-824. 129p. Dep. NTIS.

Research progress is reported on FFTF component qualification testing, sodium oxide deposition and removal from cooling system surfaces, mass transport effects on LMFBR cladding and structural materials, radiation damage in cladding and structural materials, and helium production in reactor materials caused by nuclear reactions. (J.R.D.)

415 (GEMP-724) GE-NSP UNCLASSIFIED CONTRIBUTION TO THE 29th HIGH TEMPERATURE FUELS COMMITTEE MEETING AT GENERAL ELECTRIC CO., BREEDER REACTOR DEVELOPMENT OPERATION, DECEMBER 8–10, 1969. Brassfield, H. C. (comp.) (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). Dec 1969. Contract AT(40-1)-2847. 73p. (CONF-691228). Dep. NTIS.

Results of melting point studies on BeO, ZrO_2, and UO_2-ThO_2 solid solutions are presented along with data and information on compatibility of UO_2 with stainless steel. Information is also included on crystal structure and properties of sodium uranates. Methods of estimating low-cycle fatigue in materials are discussed along with short-term tensile test methods and development of high-purity Mo for LMFBR fuel cladding. Fabrication of Re and W alloy thermocouple sheathing is described. (J.R.D.)

416 (RISO-244) METALLURGY DEPARTMENT ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1971. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1971. 42p. Dep. NTIS (U. S. Sales Only).

Nuclear materials research is reported on development of UO_2–Zircaloy fuel elements for water-cooled reactors. General materials research is summarized on mechanical properties of metals, alloys, ceramics, and composites. Work in materials technology was directed toward joining methods, nondestructive testing, and equipment control. (J.R.D.)

417 (TID-25798) APPLICATIONS OF FUNDAMENTAL MATERIALS RESEARCH. Ianniello, L. C. (Division of Research (AEC), Washington, D. C.). Aug 1971. 139p. Dep. NTIS.

A compilation of examples of the paths or histories of specific applications of fundamental materials research is presented. A brief discussion is included of the overall merit and risk character of the research, to place it in perspective. From this examination of one total program, the Metallurgy and Materials Research program, some general conclusions are drawn concerning the application of fundamental materials research results. (auth)

418 NUCLEAR PROSPECTS AND THE ENERGY CRISIS. Nellestyn, A. (Royal Military Coll. of Canada, Kingston, Ont.). Eng. Dig. (Toronto); 17: 38-40(20 May 1971).

The world's reserves of energy in nuclear fuels (uranium, thorium, deuterium) greatly exceed those in fossil fuels (coal, oil and natural gas). Furthermore, the energy of processed nuclear fuels is in a form far more concentrated and intense than in processed conventional fuels. Nuclear fuels are expected to supplement, not supplant, fossil fuels in curbing the power crises. Problems will not be solved by "rationing" or reducing energy requirements but rather by doing a better job of producing the power while minimizing the impact on the environment. An intelligent and responsible balance between environment and power needs must be established and incorporated into future designs. (auth) (Canada)

419 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. August 1971. Band 5, Heft 8. 181 Referate (Register-Nr.2912-3281), 50 Referate (Register-Nr.374 T-423 T). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. August 1971. Vol. 5, No. 8. 181 Abstracts (Register No. 2912-3281), 50 Abstracts (Register No. 374 T-423 T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H (1971). 116p. (In German and English).

420 ESTIMATING THE TEMPERATURE LIMITS OF THE SUBSOLIDUS STATE OF A MULTICOMPONENT SYSTEM. Berezhnoi, A. S. (Inst. of Geochemistry and Physics of Minerals, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 6: 1228-31(Aug 1970).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 6: 1396-1400(Aug 1970).

Statistical ana'ysis can be used to find the relations between the melting points of eutectics in multicomponent systems and the number of components from data for components and systems with small numbers of components, in particular from the values of T_2/T_1. Results of analysis of the distribution of the values of this ratio for various components and numbers of components were used to establish mean and limiting values of these ratios for various groups of systems. It is shown that particular eutectic systems cannot contain an unlimited number of components. (auth)

Corrosion and Erosion

Refer also to abstracts 582 and 1635.

421 (BARC/I-82) WATER CHEMISTRY STUDIES: INHIBITION OF CORROSION BY THE PERTECHNETATE ION. A REVIEW. Mathur, P. K.; Venkateswarlu, K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 11p. INIS.

Experimental work done on the corrosion inhibition properties of technetium-99 is reviewed. It is pointed out that the pertechnetate ion in the concentration range of 5 to 50 ppM is an excellent corrosion inhibitor for different varieties of iron and steel. The potentialities of pertechnetate as a corrosion inhibitor in water-cooled nuclear reactors remains to be fully explored and exploited. Attempts are already underway in the USA to use this ion for preventing corrosion in a boiling water reactor. (INIS)

422 (EURFNR-911) LONG-TIME CORROSION STUDIES ON AUSTENITIC CrNi STEELS AND NICKEL-BASE ALLOYS IN SUPERHEATED STEAM (620°/1 atm), WITH SPECIAL ATTENTION TO THE BEHAVIOR OF COLD-WORKED MATERIAL SURFACES. Leistikow, S.; Berg, H. v.; Pott, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translation of report KFK-1301. 84p. (In English and German). Dep. NTIS.

Work performed under United States–Euratom Fast Reactor Exchange Program.

As contribution to a suitable choice of cladding materials for nuclear superheat reactors seven superheat materials were tested in semidynamic steam loop experiments at 620°C, and 1 atm during 5000 hours and in three different surface-or bulk conditions. The experiments were evaluated by gravimetric measurements, chemical analysis of the steam condensate, and metallography. The results verified the increased corrosion resistance of nickel alloys in case of annealed material, the effect of increasing corrosion in case of oxidation of chromium depleted surfaces or coarse grain structures. Cold worked specimens of all alloys tested corroded uniformly and to an extent which was strongly diminished in the case of the CrNi steels. The high corrosion resistance which was

built up by selective chromium diffusion and oxidation proved its long-time effectiveness through 10,000 hours of testing. (auth)

423 (JUL-718-RW) MOLTEN SALT BREEDER STUDY (FINAL REPORT). MATERIAL INVESTIGATIONS. Ali Khan, I. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Dec 1970. 97p. (In German). Dep. NTIS (U. S. Sales Only).

In the framework of the molten salt breeder study, corrosion behavior of several structural materials was investigated. Molten fluoride salts (76 mol% NaF-12 mol% ThF_4-12 mol% UF_4) were used in an anisothermal loop. Chromium-nickel steels with the addition of magnesium were protected against corrosion at 750°C completely, at 850°C significantly. Several other types of steels containing various amounts of chromium, nickel, niobium, molybdenum, and vanadium were studied. Uranium, magnesium, and titanium were used as corrosion inhibitors. Ferritic steel was heavily corroded by the molten salt; addition of magnesium and titanium provided no protection. The anisothermal loop systems, consisting of steel 4988 and containing molten salt and lead, showed only minor corrosion up to 850°C. (H.B.G.)

424 (JUL-721-RW) CORROSION BEHAVIOR OF STEELS AND HIGH MELTING METALS COMPARED TO LEAD IN ANISOTHERMAL CIRCULATION SYSTEMS. Ali Khan, I.; Krawczynski, S. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Dec 1970. 116p. (In German). Dep. NTIS (U. S. Sales Only).

In the framework of the molten salt breeder study, the corrosion behavior for chromium- and chromium-nickel steels as well as for the high-melting-point metals vanadium, niobium, zirconium, and several of their alloys was studied. The thermoconvection loops consisted of 4510 and 4580 steels, and contained molten lead. At 620°C, the high-melting-point metals showed no corrosion effect during 1656 hours. If, however, the samples were connected to chromium-steel, corrosion occurred within 783 hours. Chromium- and chromium-nickel steels were strongly corroded by the molten lead already at 600°C. Samples of chromium-nickel steel stabilized with niobium and titanium were practically dissolved by molten lead within 306 hours at 700°C. Several additional alloys were also studied. (H.B.G.)

425 (RD/B/N-1931) CARBON BEHAVIOUR IN SODIUM SYSTEMS. PART II. PREDICTED CARBON TRANSFER. Hobdell, M. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug 1971. 27p. (CFR-BMWP-P-71-25). Dep. NTIS (U. S. Sales Only).

Available thermodynamic data was used to estimate carbon potentials of various steels, metal carbides, and sodium-carbon solutions. Chemical potential-temperature diagrams were constructed and used to predict the magnitude and direction of the thermodynamic driving force for carbon transfer in sodium-steel systems. It is concluded that in a sodium-cooled reactor, structural and cladding materials will initially carburize, although in the long term decarburization could occur in hot regions. (auth)

426 (Y-1800) OXIDATION PROPERTIES OF TWO URANIUM ALLOYS (U-16.6 AT. % Nb-5.6 AT. % Zr AND U-21 AT. % Nb). Cathcart, J. V.; Pawel, R. E.; Petersen, G. F. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 26 Oct 1971. Contract W-7405-eng-26. 37p. Dep. NTIS.

The fundamental oxidation characteristics of two uranium-base alloys (U-16.6 at. % Nb-5.6 at. % Zr and U-21 at. % Nb) in the temperature range from 500 to 1,000°C in oxygen at 0.05 torr have been determined. Both alloys undergo large dimensional changes during oxidation at temperatures above 650°C due to stresses generated in the oxide during oxidation. Stresses estimated at one million psi are shown to develop in the oxidizing specimens. A mechanism for the generation of these stresses was proposed. (auth)

427 PROTECTIVE COATINGS ON METALS. VOLUME 3. Samsonov, G. V. (ed.). New York; Consultants Bureau (1971). 210p.

Translated from Zashchitnye Pokrytiya na Metallakh by Z. S. Michalewicz.

Thirty-nine articles are included in the volume. A separate abstract was prepared for fifteen of the articles. The remaining articles were not considered to be in scope for NSA. (J.R.D.)

For abstracts of individual papers see: 428-436, 470, 535, 536, 582, 583, and 616.

428 PRODUCTION OF COATINGS ON METALS IN A GLOW DISCHARGE. Prokoshkin, D. A.; Arzamasov, B. N.; Ryabchenko, E. V.; Mikhailov, I. A. (Bauman Moscow Higher Technical Coll.). pp 1-15 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

A mechanism is proposed for the kinetics of nitriding, siliconizing, aluminizing, and other thermodiffusional impregnation processes for metals in glow discharges. In the flow-discharge zone, the amount of energy stored in the medium increases as a result of ionization. This high-energy state improves thermodynamic and kinetic conditions for the formation of gaseous medium components responsible for transfer of the diffusing element to the metal surface being impregnated. The atomic nitrogen ion becomes such a component in the case of nitriding, while $SiCl_2$ and $AlCl_2$ appear to perform this function in siliconizing and aluminizing. All phenomena occurring within the ionized gas must be regarded as belonging to the first stage of the process. The second stage of the process involves phenomena taking place at the gas-metal interface, i.e., the chemical disproportionation reactions of the compounds $SiCl_2$ and $AlCl_2$ and the chemisorption of atomic and ionized nitrogen in nitriding. A state of high energy of an ionized gaseous medium, of course, decreases the activation energy of surface processes (for instance, diffusion along a surface, chemisorption). The rate of thermodiffusional impregnation of a surface metal layer shows a corresponding increase. In the third stage, the chemisorbed element diffuses into the metal. The ionized state of the gaseous glow-discharge medium clearly activates primarily the first and second stages of the process. However, the accelerated thermodiffusional impregnation of metals in glow discharges cannot be attributed solely to the influence exerted by gas ionization. A metal being subjected to glow-discharge impregnation is located both in a directional electric field and a rarefied gaseous environment. This must give rise to purification of the metal surface as a result of a partial cathodic elimination of various adsorbed impurities, nucleation of new, physically pure metal surfaces under the action of electrostatic field forces, intense physical impregnation of the surface metal layer with the diffusing element in consequence of ionic bombardment and implantation of ions in the metal. The combined action of all these factors leads to an acceleration of the diffusional growth of coatings in a glow discharge compared with the orthodox gas impregnation techniques. (auth)

429 DEPOSITION OF A PROTECTIVE COATING FROM THE GASEOUS PHASE ON SPHERICAL PARTICLES IN A FLUID BED. Klevtsur, S. A.; Sedel'nikov, T. Kh.; Samoteikin, V. V.; Kuleshov, I. M. (Inst. of Physical Chemistry, Moscow). pp 16-26 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

A review of developments related to fluidized bed deposition of coatings is presented. It is noted that particle coating using fluidized bed methods offers a way of producing pure layers of refractory metals. Examples are included of pyrocarbon deposition from methane and Nb deposition on graphite by $NbCl_5$ decomposition. (J.R.D.)

430 DISTRIBUTION OF CARBON IN PROTECTIVE CHROMIUM, NICKEL, AND SILICON COATINGS ON MOLYBDENUM. Gruzin, P. L.; Zemskii, S. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). pp 49-54 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

It was shown that, at high temperatures, chromium, nickel, and silicon used as protective coatings on molybdenum give rise to a redistribution of carbon in the diffusion zone and adjoining molybdenum layers. This redistribution, which depends on the influence exerted by these materials on the thermodynamic activity coefficient of carbon in molybdenum and the ratio of the values of this coefficient in the coatings and molybdenum, may significantly affect the service performance of the coatings. Carbon becomes distributed along the grain boundaries and may migrate to regions of increased impurity concentration or regions of high density crystal structure defects (or regions with local concentrations of elastic stresses). (auth)

431 DIFFUSION OF ANIONS AND CATIONS DURING THE OXIDATION OF NIOBIUM CONTAINING VANADIUM AND TITANIUM. Prokoshkin, D. A.; Vasil'eva, E. V.; Lazarev, E. M. (Inst. of Metallurgy, Moscow). pp 71-4 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Results of air oxidation tests of Nb-base-Ti-alloys are presented. The content of Ti and V in test specimens were varied. The specimens were tested in air at 900 to 1200°C. Test results are presented graphically and discussed. (J.R.D.)

432 BORIDING OF SPHERICAL POWDERS OF REFRACTORY METALS. Krasnov, A. N. (Inst. of Materials Science,

Kiev). pp 87-91 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

A study was made of the diffusion impregnation of spherical niobium, molybdenum, and tungsten powder particles with boron. It is demonstrated that the technique employed is suitable for both preparing boride coatings on powder particles and through boriding, i.e., producing spherical boride powders of the corresponding metals. (auth)

433 EVALUATION OF THE EFFECTIVENESS OF COATINGS USED FOR PROTECTION AGAINST GAS PICKUP. Archakov, Yu. I.; Sokiryanskii, L. F.; Maksimova, L. G.; Mozhaev, S. S. (All-Union Scientific-Research Inst. of Petroleum Chemistry, Leningrad). pp 162-6 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

A method of predicting the efficiency of protective coatings for Ti, Zr, and Nb is discussed. The method is based on calculations incorporating values for diffusion coefficients in the coating and substrate and values for equilibrium concentrations of the diffusing substance at diffuser-coating or diffuser-substrate interfaces. (J.R.D.)

434 SURFACE IMPREGNATION OF ZhS6K ALLOY WITH THREE ELEMENTS. Zemskov, G. V.; Kogan, R. L.; Khmelevskaya, M. E.; Koss, E. V.; Viderman, V. S. (Odessa Engineering Inst.). pp 172-6 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

The possibility has been established of producing three-component aluminum + chromium + silicon and aluminum + zirconium + silicon coatings in nickel-base alloy containers with liquid seals, using impregnating mixtures consisting of powders of these elements. A study was made of the influence exerted by the proportions of the alloying elements in impregnating mixtures on the structure and oxidation resistance of the resulting layers. The optimum coating composition, exhibiting the highest oxidation resistance, was determined. (auth)

435 STRUCTURE AND PROPERTIES OF HEAT-RESISTANT ALLOYS WITH VACUUM DIFFUSION COATINGS. Ponomarenko, E. P.; Belov, Yu. K.; Petrovskaya, L. M. (Ukrainian Scientific-Research Inst. of Special Steels, Zaporoozhe, USSR). pp 181-6 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Results are presented of an investigation into the simultaneous impregnation of nickel alloys with chromium, aluminum, and titanium from a "multipoint" metallizer with the required porosity has demonstrated that, compared with the vacuum contact technique (in powder), the vacuum contactless method seems to hold much more promise for the industrial application of multicomponent diffusion coatings. The temperature ceiling in the vacuum contactless process is much higher, and the composition of the sublimated phase and sorption of multicomponent metallizer vapors by the surface of the basis material are controllable. (auth)

436 SURFACE PROTECTION OF HEAT-RESISTANT ALLOYS AGAINST OXIDATION. Yakshina, O. K.; Zimina, L. N.; Pershina, N. F.; Burova, N. N. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). pp 187-91 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Results of an investigation of protective coatings for Ni-base alloys EI 827, EP 109, and EP202 are presented. Surfaces were aluminized and chromoaluminized at 850 and 1050°C respectively. It was found that pipes and tubes with a diffusion zinc coating applied by the new technique possess high corrosion resistance in oil wells operating by the compressor technique and in corrosive industrial waters used in by-product coke plants; aluminized and diffusion chromized steel pipes operate satisfactorily in condensed gas wells. (J.R.D.)

437 INTERACTION OF OXYGEN WITH POLYCRYSTALLINE TUNGSTEN. II. CORROSIVE OXIDATION. King, David A.; Madey, Theodore E.; Yates, John T. Jr. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys.; 55: No. 7, 3247-53(1 Oct 1971).

The kinetics of formation of a corrosive oxide layer of apparently unlimited thickness during the interaction of oxygen with a polycrystalline tungsten filament at temperatures between 500 and 1000°K has been investigated by line-of-sight flash desorption mass spectrometry. The major desorption product from this multilayer oxide film is WO_2, which desorbs over the temperature range 1000 to 1300°K. The rate of formation of the oxide film was shown to be directly proportional to the oxygen gas phase pressure at pressures $\lesssim 10^{-4}$ torr. A study of the temperature dependence of the oxidation rate revealed that the formation of the WO_2-producing oxide layer proceeds through two distinct steps; these occur subsequent to the first three stages in the interaction of oxygen with W characterized in Paper I (J. Chem. Phys., 55: 3236 (1971)). In the final state of oxidation, the rate is shown to be independent of the thickness of the oxide film. The results are in qualitative accord with the theoretical model of Mott. Desorption of the oxide film is a zero order process, with a desorption activation energy of 420 kJ mol^{-1}. (auth)

438 INTERACTION OF OXYGEN WITH POLYCRYSTALLINE TUNGSTEN. I. STICKING PROBABILITIES AND DESORPTION SPECTRA. King, David A.; Madey, Theodore E.; Yates, John T. Jr. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys.; 55: No. 7, 3236-46(1 Oct 1971).

The interaction of oxygen with a polycrystalline W filament has been studied in the temperature range 300 to 1200°K and for exposures between 10^{-7} and 1 torr-sec. Both sticking probabilities and desorption spectra have been measured. After low exposures ($<2 \times 10^{-6}$ torr-sec), the adsorbate is all desorbed as O atoms with first order kinetics. With higher exposures, oxygen is removed as oxides: WO, WO_2, WO_3, W_2O_5. The desorption spectra for each of these species are complex, and nine distinct and reproducible oxide states are identified. Saturation coverages in each of these states are independent of adsorption temperature in the range 300 to 1200°K. At a total coverage of 8.5×10^{14} O_2 molecules cm^{-2}, 2.2×10^{14} O_2 molecules cm^{-2} are desorbed as oxides; after exposures $>10^{-2}$ torr-sec at 300°K, the total uptake rises to 15×10^{14} O_2 molecules cm^{-2}. At temperatures between 500 and 1000°K and exposures up to 1 torr-sec, a multilayer oxide film is formed of unlimited thickness. The desorption product from this oxide film is predominantly WO_2, which desorbs in the region of 1200°K. The kinetics of adsorption and desorption are evaluated and discussed. (auth)

439 REPLY TO COMMENTS BY B. COX ON THE INFLUENCE OF OXIDE STRESS ON THE BREAKAWAY OXIDATION OF ZIRCALOY-2. Bradhurst, D. H.; Heuer, P. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Mater.; 41: No. 1, 101-5(Oct 1971).

In reply to B. Cox (J. Nucl. Mater.; 41: No. 1, 96-100 (Oct. 1971)), the authors of the original article still consider that there is adequate evidence for the existence of cracks of the type necessary to explain breakaway, namely, lateral cracks together with occasional interconnecting coarse cracks intersecting the surface, and they are confident that the lateral cracks were not caused by the polishing technique. All specimens used in the stress measurements were mounted and polished using the same technique. Lateral cracks were present in all post-transition oxide films on Zircaloy-2 but not in the pre-transition films. Films close to transition typically showed lateral cracks along the metal-oxide interface and cracks intersecting the oxide surface at specimen edges. It is argued that the processes occurring during transition can be satisfactorily explained in terms of the mechanical breakdown of the oxide at the metal-oxide interface. (P.C.H.)

440 COMMENTS ON THE PAPER THE INFLUENCE OF OXIDE STRESS ON THE BREAKAWAY OXIDATION OF ZIRCALOY-2 BY D. H. BRADHURST AND P. M. HEUER. Cox, B. (Chalk River Nuclear Labs., Ont.). J. Nucl. Mater.; 41: No. 1, 96-100(Oct 1971).

Evidence for each of the two hypotheses to explain the transition commonly observed in the oxidation kinetics of Zr alloys is summarized, pointing out the information that must be obtained if a distinction between the two is to be made. The two hypotheses are termed the mechanical-failure hypothesis and the recrystallization hypothesis. It was concluded that at present there appears to be no evidence uniquely supporting the mechanical-failure hypothesis as a general explanation of the transition in the oxidation kinetics of Zr alloys. (P.C.H.)

441 OXIDE PARTICLES ON ULTRA-THIN RHENIUM FILMS STUDIED BY ELECTRON MICROSCOPY. Frederiksson, H.; Kasemo, B.; Marklund, I. (Chalmers Univ. of Tech., Gothenburg, Sweden). Thin Solid Films; 8: No. 1, 61-8(Jul 1971).

Oxide particles, which form in air on evaporated rhenium films, have been investigated by electron microscopy. The mean size of the particles decreases with increasing depositon temperature in the range 25 to 500°C. For identical deposition parameters, films on SiO substrates oxidize more readily than films on NaCl. These features are attributed to differences in the structural order of the rhenium films. When the films become continuous the oxidation rate is greatly reduced. From electron diffraction patterns, the space lattice of the oxide was determined to be bcc ($a = 13.1 \pm 0.2$ Å). It is deduced that the oxide is a new modification of Re_2O_7. (auth)

442 QUASIEQUILIBRIUM TREATMENT OF GAS–SOLID REACTIONS. III. RATE OF VOLATILIZATION OF TUNGSTEN BY HIGH-TEMPERATURE OXIDATION. Batty, J. C. (Utah State Univ., Logan); Stickney, R. E. Oxidation Metals; 3: No. 4, 331-55(Jul 1971).

Theoretical predictions computed on the basis of the quasi-equilibrium treatment of gas solid reactions are compared with existing experimental data on the rate of volatilization (erosion) of solid tungsten by reaction with gaseous O_2 at high temperature ($\sim 1300° \lesssim T \lesssim 3600°K$) and low pressure ($4.5 \times 10^{-7} \leq p_{O_2} \leq 11.5$ torr). The only unknown parameter in the analysis is the equilibrium probability, ζ_{O_2}, defined as the fraction of the impinging O_2 molecules that attain thermochemical equilibrium at the tungsten surface rather than undergoing nonreactive scattering (e.g., reflection). An approximate expression for ζ_{O_2} is estimated by a straightforward empirical procedure that is consistent with the quasiequilibrium treatment. The theoretical results based on this expression for ζ_{O_2} provide a reasonably accurate explanation of experimental data obtained in different laboratories for a wide range of conditions. The observation that the volatilization rate, Σ_W, passes through a maximum as temperature increases can be explained by dividing the temperature range into three regions: (a) In the lowest region, the principal reaction products are oxides of the form $(WO_3)_n$, and Σ_W increases exponentially with T because ζ_{O_2} appears to be an exponential function of T; (b) In the intermediate region, the formation of volatile oxides decreases sharply with increasing T because atomic oxygen becomes the thermodynamically favored reaction product, thereby causing Σ_W to decrease with increasing T; (c) In the highest region, Σ_W again increases with T as a result of the formation of WO and the sublimation of W. (auth)

443 STUDY OF GAS–SOLID CHEMICAL INTERACTIONS BY NOBLE GAS MOLECULAR BEAMS. IV. ADSORPTION STATES AND OXIDATION OF MOLYBDENUM AND RHENIUM. Ollis, D. F.; Lintz, H. G.; Pentenero, A.; Cassuto, A. (CNRS, Nancy). Surface Sci.; 26: No. 1, 21-40(Jun 1971).

The present work is the fourth part of a study using a molecular beam of noble gas atoms (He,Ne) to probe the state of a surface during oxidation at low oxygen pressure (10^{-5} to 10^{-9} torr) and temperatures from ambient up to 2300°K. This technique provides direct information concerning the number of important binding states, the heats of desorption, and the surface coverage as a function of metal temperature and oxygen pressure. The experimental results indicate two- and one-oxygen binding states on Mo and Re, respectively, with binding energies of 139 and 93 kcal/mol for Mo and 127 kcal/mol for Re. The implication of these results in understanding the fundamental oxidation mechanisms of Mo and Re is discussed with the aid of models which have satisfactorily described tungsten oxidation under comparable conditions. It appears that the true mechanism for molybdenum is the same as that for tungsten whereas that for rhenium is strikingly different, contrary to previous interpretations. (auth)

444 INITIATION MECHANISM FOR EXPLOSION DURING COMBUSTION OF METAL DROPLETS. Levine, Herman S. (Sandia Labs., Albuquerque, N. Mex.). High Temp. Sci.; 3: No. 3, 237-43(May 1971).

The theory of homogeneous bubble nucleation in superheated liquids is used to examine critical conditions for sac formation during combustion of zirconium drops in oxygen-nitrogen atmospheres. The required excess critical pressure for nucleation was found to be unusually high based on estimated values for the surface tension of the Zr–O–N system. It is shown that a simple bubble nucleation process alone is inadequate to account for the initiation stage of the Zr droplet explosion process. The existence of chemisorbed species on the surface of the embryos leads, via a modified theory, to a decrease in the required critical pressure to more reasonable values. (auth)

445 OXIDATION OF DIFFUSION COATINGS ON A NIOBIUM ALLOY. Luk'yanov, V. M.; Zemskov, G. V.; Kogan, R. L.; Viderman, V. S. Metallofizika; No. 32, 127-30(1970). (In Russian).

The oxidation of diffusion coatings of various simple and complex types (Cr, Ti, and Si, singly or together) on a Nb–Ni alloy was studied by microscopy and x-ray and electron diffraction. Oxidation was carried out at 700 to 1200°C for up to 100 hr. In the case of a complex coating the sequence of oxide formation was: NbO, TiO_2, SiO_2, Cr_2O_3. Further oxidation increased the proportion of Cr_2O_3 in the oxide film. (Metals Abstr.)

446 OXIDATION AND THE ASSOCIATED MORPHOLOGICAL CHANGES IN Zr–Ni BINARY ALLOYS. Kondo, T.; Kimura, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 41: No. 2, 121-32(Nov 1971).

Thermogravimetric measurements on the oxidation of three Zr–Ni alloys were made, and the characteristic features of the kinetics were interpreted in terms of the morphological changes during oxidation. The process followed the parabolic rate law only in the early stage of oxidation, then all three alloys tended to deviate from the law to lower rates as oxidation proceeded. Only about 0.19 wt % nickel was found in the ZrO_2 film, independent of the original composition of the alloy or the duration of oxidation. The negative deviation was due to limited incorporation of nickel in the oxide leading to the condensation of nickel in the oxide/metal interface. Oxygen dissolution occurred underneath the oxide, inducing inward diffusion of nickel to form nickel-depleted zones in which a pronounced grain coarsening resulted. The effect of the morphological changes on the kinetics is discussed in connection with the role of nickel and the dissolved oxygen. (auth)

447 OXIDATION OF VANADIUM WITH OXYGEN IN HELIUM. Kohl, H. K. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). J. Nucl. Mater.; 41: No. 2, 231-4(Nov 1971).

The rates of oxidation of V in He containing 0.1 to 10 vol % O at 600 to 900°C were measured. The partial pressure of the O was 0.75 torr and the He pressure varied between 7 and 682 torr. The reaction rate v is represented by $v = 5.14 \times 10^{-6} \exp(4340/RT) P_{O_2}/P_{He}^{\frac{1}{2}} gO/cm^2$ sec where R represents the gas constant, T the absolute temperature in °K. (J.R.D.)

448 OXIDATION AND SPALLING BEHAVIOUR OF 20 PERCENT Cr/25 PERCENT Ni/Nb-STABILISED STEEL UNDER THERMAL CYCLING CONDITIONS. Francis, J. M.; Curtis, M. T.; Hilton, D. A. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater.; 41: No. 2, 203-17(Nov 1971).

A study was made of the effects of large and small thermal transients on the oxidation and oxide-spalling behavior of 20% Cr/25% Ni/Nb-stabilized steel in carbon dioxide. Accurate thermogravimetric ($-\Delta W/\Delta T$) profiles for various cooling conditions have been determined which show that the weight of spalled oxide is directly proportional to the drop in temperature below 650°C. During the early stages of oxidation, a reduction in temperature of 100°C or more can damage the Cr_2O_3 film formed on the steel and this temporarily increases the oxidation rate. However, the effect is not perpetuated since the process is self-healing. The new scale formed has an improved thermal-shock resistance which is linked with the incorporation of iron oxides in the surface scale. The improved oxide adhesion observed after several major thermal cycles is also related to changes in oxide composition. The results suggest that thermal cycling is unlikely to have a significant deleterious effect on the long-term oxidation behavior of this steel. (auth)

449 CORROSION EXPERIENCE WITH THE DRAGON PRIMARY HEAT EXCHANGERS. Gray, P. S.; Salter, W. B. (Dragon Operations Branch, Winfrith, Eng.). J. Brit. Nucl. Energy Soc.; 10: No. 3, 207-15(Jul 1971).

Waterside corrosion experience with the Dragon primary heat exchangers is reviewed. Tube failures resulted from the inability of volatile alkalis to control corrosion under conditions produced by steam flow instabilities and high heat fluxes. Investigations into the uniformity of gas distribution and steam flow stability leading to the development of a satisfactory heat exchanger design are described. Corrosion was eliminated by these modifications together with the use of the involatile base lithium hydroxide. The importance of careful attention to these details of design in once-through boilers, where only volatile alkalis can be used, is stressed. (auth)

450 PROTECTION OF ELECTROLYTIC CADMIUM POWDER AGAINST OXIDATION DURING WASHING AND DRYING. Zavgorodnyaya, E. F.; Podol'skaya, N. V. (Dnepropetrovsk State Univ., USSR). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 109-11(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 105-7(Jan-Feb 1970).

Cadmium powder is widely used as one of the components of cermet alloys, for the manufacture of contact materials in the electric industry, pressed electrodes for chemical current sources, and for other purposes. Cadmium powders obtained by various methods are highly dispersed, active, and easily oxidized. To protect freshly reduced electrolytic powders of iron, copper, and zinc against oxidation during washing and especially during drying it is recommended that the drying time be shortened by washing the powders with highly volatile solvents, drying in a vacuum or a N_2 or H_2 atmosphere, production on the powder particles a hydrophobic film of surface-active agents, or passivation in solutions of oxidants. There is little information on the protection of highly dispersed cadmium powder against oxidation. (auth)

451 SUBOXIDES IN OXIDATION OF TRANSITION METALS. Kornilov, I. I.; Glazova, V. V. (Inst. of Metallurgy, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 2, 162-6(Mar-Apr 1970).

Translated from Zashch. Metal.; 6: No. 2, 176-81(Mar-Apr 1970).

It is shown on the basis of an analysis of published data and results of investigations that in the oxidation of transition metals the formation of nonvalence oxides or suboxides takes place in addition to the formation of valence oxides. Many anomalies in the oxidation of these metals can be explained by the formation of this type of oxide. (auth)

452 SPECIAL CHARACTERISTICS OF THE HIGH-TEMPERATURE OXIDATION OF NICKEL AND ITS COMPOSITION WITH OXIDES. Pashkova, O. A.; Zhuk, N. P.; Opara, B. K.; Burtseva, N. I. (Moscow Inst. for Steel and Alloys). Prot. Metals (USSR) (Engl. Transl.); 6: No. 5, 540-2(Sep-Oct 1970).

Translated from Zashch. Metal.; 6: No. 5, 591-3(Sep-Oct 1970).

Results of research on oxidation of Ni at 800 to 1200°C are presented. Data are also included on reactions of Ni with ThO_2, ZrO_2, HfO_2, TiO_2, and Al_{203} at 800 to 1200°C. (J.R.D.)

453 KINETICS OF THE DISSOLUTION OF MOLYBDENUM IN 2 N HNO_3 CONTAINING UREA. Putilova, I. N.; Suponitskaya, I. I. (Moscow Technological Inst. of the Food Industry). Prot. Metals (USSR) (Engl. Transl.); 6: No. 5, 520-1(Sep-Oct 1970).

Translated from Zashch. Metal.; 6: No. 5, 571-2(Sep-Oct 1970).

Urea was tested for use as a reaction regulator in Mo alloy treatments using HNO_3. Studies of the after effects of the urea moderator showed that no compounds of Mo with urea or their reaction products are produced in the HNO_3 reactions which are insoluble in HNO_3 or prevent penetration of the acid ions into the Mo surfaces. (J.R.D.)

454 BEHAVIOR OF CADMIUM IN NaCl SOLUTIONS. Kadyrov, M. Kh.; Golubev, A. I. (Central Scientific Research Inst. of Building Metal Constructions, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 5, 517-19(Sep-Oct 1970).

Translated from Zashch. Metal.; 6: No. 5, 569-71(Sep-Oct 1970).

The behavior of Cd in NaCl and NaCl–NaOH solutions was investigated at room temperature. After cathodic polarization, direct and reverse cathodic and anodic polarization curves were plotted using values measured using a potentiostat. Conclusions drawn by analysis of the data are included. (J.R.D.)

455 CORROSION RESISTANCE OF VANADIUM ALLOYS IN BOILING ACIDS. Vorob'eva, L. P.; Gulyaev, A. P.; Druzhinina, I. P. (State Scientific-Research and Design Inst. of the Rare Metals Industry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 5, 483-5(Sep-Oct 1970).

Translated from Zashch. Metal.; 6: No. 5, 537-40(Sep-Oct 1970).

Results of investigations show that vanadium is not corrosion resistant in boiling hydrochloric, sulfuric, phosphoric, or nitric acids. High alloying of vanadium is possible owing to the high solubility of many elements in it, permitting substantial changes in its corrosion resistance. Alloying with titanium increases the corrosion rate of vanadium in most cases; niobium, tantalum, molybdenum, and tungsten reduce the corrosion rate. With a sufficient amount of the alloying element an alloy can be obtained that is fully resistant up to a certain concentration of the given acid. Results show that it is possible to obtain vanadium alloys with high corrosion resistance for operation in concentrated inorganic acids at elevated temperatures. (auth)

456 INITIAL AND STATIONARY POTENTIALS OF ELECTROLYTIC RHENIUM AND RHENIUM–NICKEL ALLOY. Pishikin, A. M.; Popereka, M. Ya. (Kalinin State Pedagogical Inst., USSR). Prot. Metals (USSR) (Engl. Transl.); 6: No. 5, 481-2(Sep-Oct 1970).

Translated from Zashch. Metal.; 6: No. 5, 535-7(Sep-Oct 1970).

Results of measurements are presented of the initial and stationary electric potentials for electrodeposition of Re and Ni–Re alloys. Measurements of Re potentials were made in potassium perrhenate–ammonium sulfate–sulfuric acid solutions. Measurements of Ni–Re potentials were made in nickel sulfate–potassium perrhenate–ammonium sulfate solutions. Results are presented graphically and discussed. (J.R.D.)

457 STABILIZATION OF BOROHYDRIDE SOLUTIONS FOR CHEMICAL NICKEL PLATING. Gorbunova, K. M.; Ivanov, M. V.; Nikiforova, A. A. (Inst. of Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 5, 470-4(Sep-Oct 1970).

Translated from Zashch. Metal.; 6: No. 5, 522-7(Sep-Oct 1970).

The effects of compounds of an organic or inorganic nature on the stability of nickel plating solutions containing sodium borohydride as reducing agent were studied. Results are presented showing the dependence of the plating deposition rate and the stability of the solution on the concentration of stabilizers. (auth)

458 CORROSION OF TITANIUM–MOLYBDENUM–CHROMIUM ALLOYS. Tomashov, N. D.; Ruskol, Yu. S.; Filippov, A. F.; (and others) (Inst. of Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 5, 451-5(Sep-Oct 1970).

Translated from Zashch. Metal.; 6: No. 5, 499-504(Sep-Oct 1970).

The effects of chromium on the corrosion resistance of titanium alloyed with 5 and 10% Mo were investigated. The electrochemical and corrosion behavior of these alloys was investigated by the potentiostatic method, whereas the corrosion resistance was determined from the current and weight loss. (auth)

459 BEHAVIOR OF TITANIUM AND TITANIUM–TANTALUM ALLOYS DURING CATHODIC POLARIZATION IN NITRIC ACID SOLUTIONS. Karasev, A. F.; Stabrovskii, A. I. Prot. Metals (USSR) (Engl. Transl.); 6: No. 3, 300-1(May-Jun 1970).

Translated from Zashch. Metal.; 6: No. 3, 324-6(May-Jun 1970).

Results of a study of the electrochemical behavior of Ti, Nb and Ta are presented along with results of investigations of corrosion of Ti and Ti–Ta alloys by nitric acid solutions during galvanostatic cathodic polarization at 20 to 80°C. Ti was found to be stable under cathodic polarization in nitric acid and Ti–Ta alloys were also stable under these conditions. (J.R.D.)

460 PROTECTION OF PEARLITE STEELS AGAINST WATER CORROSION IN NUCLEAR POWER REACTORS. Gromova, A. I.; Gerasimov, V. V.; Vralev, N. Yu.; Rozenfel'd, I. L.; Persiantseva, V. P. Prot. Metals (USSR) (Engl. Transl.); 6: No. 2, 214-17(Mar-Apr 1970).

Translated from Zashch. Metal.; 6: No. 2, 227-31(Mar-Apr 1970).

Specimens of Type 20 steel completely immersed in air-saturated water containing 1 g/liter hydrazine or 10% dicyclohexylamine corroded uniformly at 20 and 80°C; the corrosion rate was almost two orders of magnitude less than for water containing no inhibitors, where pits were formed in the steel. Dicyclohexylamine (10%) can be used as an inhibitor for pearlite steel not completely immersed in water at 20 and 80°C; this compound reduced the corrosion rate along the waterline and over water to a greater extent than hydrazine. A 10% dicyclohexylamine solution is radioresistant in reactor radiation at integral doses of up to 10^{15} neutrons/cm^2 (for thermal neutrons). (auth)

461 HIGH TEMPERATURE CORROSION OF TUNGSTEN, MOLYBDENUM, AND NIOBIUM IN HYDROGEN FLUORIDE. Zotikov, V. S.; Semenyuk, E. Ya. (State Inst. of Applied Chemistry, Leningrad). Prot. Metals (USSR) (Engl. Transl.); 6: No. 2, 204-5(Mar-Apr 1970).

Translated from Zashch. Metal.; 6: No. 2, 218-19(Mar-Apr 1970).

The temperature dependence of HF corrosion of these metals was studied. Data on corrosion rates at 300 to 800°C are tabulated. (J.R.D.)

462 LAWS OF POTENTIOSTATIC PASSIVATION OF ZIRCONIUM IN SULFURIC ACID SOLUTIONS. Bondareva, T. P.; Novakovskii, V. M. Prot. Metals (USSR) (Engl. Transl.); 6: No. 2, 191-3(Mar-Apr 1970).

Translated from Zashch. Metal.; 6: No. 2, 207-9(Mar-Apr 1970).

Results of studies on potentiostatic passivation of Zr in $HzSO_4$ are presented. It was found that the logarithmic law reflects the essential characteristics of potentiostatic growth of passive films on Zr. (J.R.D.)

463 CORROSION OF MOLYBDENUM AND ITS ALLOYS IN STAINLESS STEELS IN SALT SOLUTIONS AT DIFFERENT VALUES OF THE pH. Korovin, Yu. M.; Ulanovskii, I. B. (Inst. of Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 6-9(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 9-13(Jan-Feb 1970).

Results of a study of the electrochemical and corrosion behavior of molybdenum in seawater are presented in which data

on the effects of molybdenum on the corrosion of pitted stainless steels are analyzed. (auth)

464 CORROSION RESISTANCE OF BINARY NICKEL ALLOYS IN ALKALIS. Krivosheya, V. E.; Stepanov, V. V.; Vochkanov, A. P. (Ural Polytechnical Inst., Sverdlovsk, USSR). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 23-4(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 29-30(Jan-Feb 1970).

The effects of additions of manganese, zirconium, titanium, aluminum, and silicon on the corrosion resistance of nickel were investigated. Studies were made in order to alloy nickel to reduce the porosity of welded joints in preparing welded nickel equipment. (auth)

Preparation and Fabrication

Refer also to abstracts 43, 90, and 141.

465 (AD-721308) FEASIBILITY STUDY OF NIOBIUM ALLOY CASTINGS. Quarterly Progress Report No. 4, May 1-October 31, 1970. Beauregard, R. J.; Walters, J. J. (Avco Lycoming Div., Stratford, Conn.). Jan 1971. Contract DAAG46-69-C-0163. 33p. (AMMRC-CR-70-5/4). NTIS.

The purpose of the program is to determine the feasibility of investment-casing of Nb alloys. Thirty-four castings are scheduled to be produced, using consumable-electrode arc-melting and tungsten interfaced molds to prevent mold-metal reaction. Phase I of this program concerns the optimization of mold design and preheat temperature. Phase II envisages the production of sound test specimens, followed by coating, and an environmental and mechanical testing effort. (auth) (USGRDR)

466 (BM-RI-7569) PREPARATION OF THORIUM-MAGNESIUM ALLOYS AND PURE THORIUM BY MAGNESIUM REDUCTION OF THORIUM TETRACHLORIDE. Campbell, T. T.; Robidart, G. B.; Block, F. E. (Bureau of Mines, [Washington, D. C.]). [1971]. 20p.

Studies were conducted by the Bureau of Mines to develop a process for preparing thorium-magnesium master alloys or pure thorium metal by magnesium reduction of thorium tetrachloride in a semicontinuous reactor. Thorium tetrachloride was prepared in a fluidized-bed reactor by chlorination of thorium oxide or thorium oxalate. Conditions were established for producing a suitable thorium oxide feed for a fluidized-bed reactor. Thorium tetrachloride was purified by vacuum sublimation and subsequently reduced by magnesium in a semicontinuous reactor to form thorium-magnesium alloys. Relatively pure thorium was produced by removing magnesium from the alloys by vacuum sublimation. Close to 100 percent of the thorium fed into the reactor was recovered either as metal (~93 percent) or as thorium oxide (~7 percent). The oxide can be recycled directly into the process. (auth)

467 (EUR-4474) STUDY ON THE OPTIMUM USE OF PLUTONIUM IN THE POWER INDUSTRY. Memmert, G.; Wellmann, H. (European Communities, Brussels (Belgium). Commission). May 1970. 68p. (In German). INIS.

An investigation was made into the ways of using the plutonium produced in a number of different types of nuclear power stations. In particular, the question arises whether this plutonium should be accumulated for later use in fast breeders or whether it should be recycled directly into thermal reactors. At the same time, the study deals with the question of whether it might be useful to construct special reactors, e.g., fast converters, which have a particularly high plutonium yield but are also very closely. The most important overall results of these investigations were: reactors with plutonium recycling are most favorable for all the optimum cost systems considered. If these types are not accepted and the plutonium obtained from light-water reactors is accumulated for use in fast breeders, then costs for the whole system increase and the use of fast converters is advantageous from the cost standpoint. This also applies if such reactors are only in use for a transition period of a few years. (INIS)

468 (IS-T-460) PREPARATION OF URANIUM METAL AND DENSE UO_2 SHAPES BY THE CARBON REDUCTION OF U_3O_8. McClusky, James Keith (Ames Lab., Iowa). May 1971. Contract W-7405-eng-82. 173p. Dep. NTIS.

Thesis.

Carbon reduction of U_3O_8 has been successfully employed to yield high-purity uranium metal in massive form by a two-step laboratory-scale process. The first operation consists of preparing an electrically conducting uranium intermediate product (oxycarbide) by partially reducing U_3O_8 with 7.2 moles of carbon in a graphite crucible under vacuum conditions at temperatures between 1550 and 1950°C. The refining step consists of heating this product by self-induction under vacuum to yield liquid metal in a uranium oxide crucible assembly at temperatures up to about 2200°C. Uranium containing a total carbon, oxygen and nitrogen concentration of less than 400 ppM can be prepared by this process. The yield of metal in the ingot on a 200-g-of-metal scale is greater than 80%. A laboratory-scale process for the preparation of dense UO_2 shapes and crucibles by the carbon reduction of U_3O_8 has been developed. The starting oxide, production grade UO_3, is first wet ball-milled. Next, excess ammonium hydroxide is added to the slurry to precipitate the soluble uranium compounds. The resulting uranium trioxide-ammonium diuranate slurry is then filtered, washed, dried, powderized and calcined to U_3O_8 at 700°C. Compacts prepared from charges of this U_3O_8 with 0.7 mole of carbon (graphite powder) by cold pressing at 30,000 lb/in^2 sintered to greater than 95 percent of theoretical density after two hours in CO_2 at 1400°C. Results of this study were applied to preparing dense UO_2 crucibles by jolt packing. The mixed charge of U_3O_8 and carbon is jolt-packed in the form of a crucible within a graphite mold and then heated to 900°C under nitrogen followed by CO_2 sintering. (auth)

469 (LA-4752) HIGH-ENERGY-RATE FORMING OF REFRACTORY METALS. Sandstrom, Donald J.; Fisher, Dale S. (Los Alamos Scientific Lab., N. Mex.). Sep 1971. Contract W-7405-eng-36. 14p. Dep. NTIS.

A variety of techniques for forming refractory metals, high-temperature alloys, and cermets are being investigated. Pneumatic mechanical forming, especially extrusion, has been used to produce a variety of shapes from refractory metal alloys and cermets. Using a conventional filled billet extrusion technique, sound, high-density W + UO_2 and Mo + U_3O tubular products have been produced. Considerable attention has been given to the design of tools used in high-temperature extrusion processes and operational experience has been employed in the redesign of tools to increase their life. Attempts have been made, with limited success because of the difficulty, to instrument the extrusion press. The application of magnetic fields to metal forming is receiving considerable attention. The magnetic field produced in a coaxial conductor carrying high, pulsed currents can be used to compact metallic powders into tubular shapes; to form tubular shapes not amenable to other joining processes; or as a technique for cladding regular or irregular shapes with suitable cladding materials. Refractory metal alloys, cermets, and refractory oxides have been formed using the theta magnetic field generated in a coaxial conductor. Comparisons of densities of materials compacted using this technique indicate an improvement over the conventional hydrostatic method. Leak-tight cladding of metals with other metals has also been accomplished. (auth)

470 SOME ASPECTS OF THE ALLOYING OF METAL SURFACES WITH VARIOUS ELEMENTS. Dubinin, G. N. (Aviation Inst., Moscow). pp 45-8 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Methods of diffusion impregnation of metal surfaces are examined. Emphasis is placed on thermodynamic calculations used to establish the character of reactions between the impregnating medium and the surface being impregnated and to select the most efficient impregnation process. (J.R.D.)

471 NUCLEAR PLANT PIPING. Traffas, Wayne H. (Gilbert Associates, Inc., Reading, Pa.). pp 21-33 of Piping Systems. Chicago; Reinhold Publishing Corp. (1970).

From HPAC conference on piping systems; Chicago, Ill. (3 Nov 1969). See CONF-691134.

The design and material considerations for nuclear plant piping are discussed. The material characteristics of particular interest include ductility, creep, fatigue, and yield strength. The significance of welded joints in the design and fabrication of nuclear piping systems is stressed. Tabulated data are presented on ASTM carbon steel and stainless steel piping specifications; pipe-end welding details; recommended welding materials and processes for welding carbon and alloy steels and chromium-nickel stainless steels; and required preheat and post-heat treatments for carbon and alloy steels. (L.C.L.)

472 METALS JOINING. Evans, R. M. (Battelle Memorial Inst., Columbus, Ohio). DMIC Rev.: 3p.(11 Sep 1970).

Recent research on the joining of Ni, Ti and other materials includes: weldability of thick sections of Hastelloy X with an Al content reduced to 0.01%; brazing of TD Ni-Cr at 2400°F under 10^{-5} torr; diffusion spot welding of TD Ni-Cr; hot isostatic bonding of TD Ni at 2000°F for 2 hr under 20,000 lb/in.^{2} pressure; bonding of solution-treated Ti alloys using titanium hydride; electron-beam

welding of β-III Ti alloy; analytical techniques for predicting both linear and nonlinear stresses and deformations of mechanically fastened joints and low-cycle fatigue properties of butt welds in HY-100 and HY-130 steel specimens prepared by gas metal-arc and shielded metal-arc welding. (Metals Abstr.)

473 REFRACTORY METALS. Maykuth, D. J.; Bartlett, E. S.; Barth, V. D. (Battelle Memorial Inst., Columbus, Ohio). DMIC Rev.; 4p.(10 Jul 1970).

Recent research on Nb, Ta, W and Cr alloys includes work on: parameters required to form beaded heat shield panels of Nb-752 and WC-129Y alloys 0.012 in. thick; influence of increased B content on the fabricability of Nb–Hf–W alloys; strengthening of refractory alloys such as Ta–50Hf and Nb–58Zr through the precipitation of stable phases; creep-rupture properties of arc-melted and powder-metallurgy W-25 Re sheet at 1650 and 2200°C; development of a slip-cast and isostatically hot pressed composite structure of W alloy fibers in a Ni–25W–15Cr–2Al–2Ti matrix for turbine bucket applications; improved procedures for preparing pure Cr wire; oxidation resistance of refractory borides, graphites, composites, coated and uncoated refractory metals, metal/oxide composites and Ir-coated graphites; phase relationships in the binary Ta–N and Hf–N systems and the ternary Ta–Hf–N system; feasibility of investment casting Nb alloys into molds coated with a W slurry; and applications of Hf–Ta alloys as oxidation resistant claddings for high-strength Nb and Ta alloys. (Metals Abstr.)

474 PROCESS FOR PRODUCING REFRACTORY METAL ALLOYS. Bonnier, Etienne; Driole, Jean; Allibert, Colette; Wicker, Alain (to Agence Nationale de Valorisation de la Recherche). French Patent 2,044,921. 15 Feb 1971. Filed 30 May 1969. (In French).

A process for the fabrication of refractory metal alloys, such as Nb–W and (or) Mo is presented. The alloy components and a nonrefractory vector metal are brought together. An inert atmosphere is created and the temperature brought up to the melting temperature of the vector metal. An equilibrium is obtained between a solid phase (solid solution of refractory metals) and a liquid solution (refractory metal alloy and vector metal). The two phases are separated and a final cooling is carried out to solidify the liquid phase thus separated from the solid phase. This procedure permits the elaboration of an extremely diluted range of solid solutions with Nb–W and/or Mo base. (P.C.H.)

475 STUDY OF ADSORPTION OF TITANIUM ON TUNGSTEN AND RHENIUM BY FIELD ELECTRON EMISSION. Anderson, J. R.; Thompson, Norman (Flinders Univ., Adelaide). Surface Sci.; 26: No. 2, 397-414(Jul 1971).

The deposition and layer growth of titanium evaporated onto tungsten and rhenium field emitter tips has been studied, and field emission average work functions measured at varying titanium layer thicknesses from less than a monolayer to several monolayers. Titanium evaporated onto a clean tungsten tip at 293°K in the submonolayer region tended to collect preferentially on atomically rough planes. With further deposition, a "pseudo-clean" emission pattern was obtained at about a monolayer coverage when the titanium atoms were concluded to be in epitaxial registry with the bcc substrate; at about this coverage, the work function for the system passed through a minimum. Further titanium deposition in excess of three monolayers resulted in a progressive roughening of the surface due to microcrystallinity: brief heating (~1 min. 1300°K) of such a surface resulted in a well-ordered layer identified as β-titanium (bcc) presumably epitaxed to the tungsten. This epitaxed layer remained indefinitely stable at 293°K. In the deposition of titanium onto a clean rhenium emitter tip at 293°K, titanium again appeared to collect on atomically rough planes in the submonolayer region. Further deposition in excess of two monolayers resulted in the formation of a well-ordered layer identified as α-titanium (hcp) probably epitaxed to the rhenium. The field emission average work functions of α-titanium and β-titanium were determined as 4.00 ± 0.05 and 3.65 ± 0.05 eV respectively. (auth)

476 RELATIONSHIP BETWEEN INTERLAMELLAR PERIOD AND GROWTH RATE IN THE UNIDIRECTIONALLY DECOMPOSED EUTECTOIDS Co_3Si AND β Ni–In. Carpay, F. M. A.; van den Boomgaard, J. (Philips Research Labs., Eindhoven, Netherlands). Acta Met.; 19: No. 11, 1279-86(Nov 1971).

Decomposition of the eutectoids Co_3Si and the β-phase in the Ni–In system, under unidirectional cooling conditions, gives aligned lamellar specimens. Unidirectional solidification of a melt of eutectoid composition in a floating zone or a Bridgman crystal growth apparatus provides the starting material. The decomposition is achieved using the same equipment. The relationship between interlamellar period λ and pulling rate R is measured in a wide range of R's. It is found that $\lambda^n R$ = constant with n = 4. A model of grain boundary diffusion is used to explain this unexpected relationship. The influence of the supercooling on the process is caused by the tendency for the disproportionation process to achieve local equilibrium between starting material and product phases. (auth)

477 INVESTIGATION OF THE MECHANISM OF ELECTRODEPOSITION OF SILVER–TUNGSTEN ALLOY FROM AN AMMONIUM SULFATE ELECTROLYTE. Kudryavtseva, I. D.; Skalozubov, M. F. (Novocherkassk Polytechnic Inst., USSR). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 61-4(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 64-7(Jan-Feb 1970).

Mechanisms involved in coprecipitation of Ag and W on cathodes are examined. It is concluded that catalytic electrochemical reduction of W on the deposited surface of silver occurs. The presence of ammonium sulfate was found to promote activation of the electrode surface thus facilitating occurrence of electrochemical reactions on it. (J.R.D.)

478 CHEMICAL NICKEL–MOLYBDENUM COATINGS FROM AN AMMONIUM CITRATE SOLUTION. Rozenblyum, R. G.; Burakov, M. R.; D'yakov, A. A.; Burakova, E. A.; Efimova, M. M. (Sverdlovsk Scientific-Research Inst. of Chemical Engineering, USSR). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 75-7(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 76-8(Jan-Feb 1970).

Electrolytic solutions for use in electrodeposition of Ni–Mo alloys were investigated. Electrolyte solutions composed of sodium citrate, ammonium chloride, ammonia, nickel chloride, sodium hypophosphite, and ammonium molybdate were found to promote the most stable deposits. (J.R.D.)

479 PROTECTING TUNGSTEN FROM HIGH-TEMPERATURE OXIDATION BY GALVANIC NICKEL PLATING ON A SUBLAYER OF CHEMICALLY DEPOSITED PALLADIUM. Kvokova, I. M.; Vinnitskaya, N. S. (Moscow Inst. of Steel and Alloys). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 78-9(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 79-80(Jan-Feb 1970).

Development of methods for chemical deposition of Pd layers on W is described. The Pd layers are used as a substrate for Ni or other protective coatings. The electrolyte is composed of palladium ammonium chloride, ammonia, trilon B, and hydrazine sulfate. (J.R.D.)

480 SURFACE TENSION IN SiO_2–BaO–B_2O_3 MELTS AND THEIR ADHESION TO CHROMIUM NICKEL STEELS. Perminov, A. A.; Popel, S. I.; Poltarak, A. M. (Ural Scientific-Research Inst. of Ferrous Metals, Sverdlovsk, USSR). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 99-102(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 97-100(Jan-Feb 1970).

Adhesion of SiO_2–B_2O_3–BaO melts on Cr–Ni steel at 1373°K was studied. It was found that a protective coating having high bond strength can be deposited on these steels. Lower polarization of boundary anions of oxygen by the cations Ba^{x3+} replacing Si^{x+i} and B^{x2+} enhances the adhesive strength of the coating. (J.R.D.)

481 METHOD FOR INVESTIGATING OXIDE FILMS WITH THE AID OF THE NUCLEAR REACTION $^{18}O(p,\gamma)^{19}F$. Zelenskii, V. F.; Khar'kov, O. N.; Kulakov, V. S.; Skakun, N. A. (Physical-Technical Inst., Kiev). Prot. Metals (USSR) (Engl. Transl.); 6: No. 2, 235-7(Mar-Apr 1970).

Translated from Zashch. Metal.; 6: No. 2, 246-8(Mar-Apr 1970).

A method for use in investigating oxide films using the proton reaction method is described. Using this method the oxygen concentration distribution on oxidized specimens can be determined and the diffusion constants of O atoms in the layer can be estimated. Results of experimental determinations of oxide film thickness using the nuclear reaction method were in agreement with gravimetric measurements. (J.R.D.)

482 ELECTROCHEMICAL POLISHING OF CHROMIUM–NICKEL–MOLYBDENUM ALLOY EP-567. Prokop'eva, T. K. (All-Union Scientific-Research Inst. of Chemical Engineering, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 2, 232-4 (Mar-Apr 1970).

Translated from Zashch. Metal.; 6: No. 2, 244-6(Mar-Apr 1970).

Results of tests in which solutions for polishing alloy EP-567 were optimized are presented. Good surfaces were produced

by room temperature electropolishing using a solution composed of 600 g/l H_2SO_4 and 600 g/l H_3PO_4. (J.R.D.)

483 CHEMICAL NICKEL-PLATING OF MOLYBDENUM. Kvokova, I. M.; Chalykh, L. E. (Moscow Inst. of Steel and Alloys). Prot. Metals (USSR) (Engl. Transl.); 6: No. 2, 227-8 (Mar-Apr 1970).

Translated from Zashch. Metal.; 6: No. 2, 240(Mar-Apr 1970).

Results of investigations are presented which show that Mo can be chemically Ni-plated from hydrazine using Al or Mg catalytic wires in sodium hypophosphite solutions. The Ni layer adheres firmly and is a reliable sublayer for Cu, Ni, Cr, and Ag layers. (J.R.D.)

484 GAS-FLAME DEPOSITION OF OXIDE COATINGS. Pirogov, Yu. A.; Svirskii, L. D. (Kharkov Polytechnical Inst.). Prot. Metals (USSR) (Engl. Transl.); 6: No. 3, 349-50(May-Jun 1970).

Translated from Zashch. Metal.; 6: No. 3, 371-3(May-Jun 1970).

Al_2O_3 and ZrO_2 coatings were flame deposited from powders on surfaces of sand-blasted steel, sand-blasted copper, polished steel, and polished glass. The morphology and properties of the coatings are described. (J.R.D.)

Properties Evaluations

Refer also to abstracts 263, 290, 711, 967–970, 972, 1553, 1566, and 1586–1588.

485 (AI-AEC-13009) EFFECT OF HELIUM ON CREEP OF TYPE 316 STAINLESS STEEL AT 700°C. Garr, K. R.; Rhodes, C. G.; Kramer, D. (Atomics International, Canoga Park, Calif.). 3 Sep 1971. Contract AT(04-3)-824. 23p. Dep. NTIS.

Small helium-injected samples of Type 316 stainless steel were creep tested in vacuum, under constant load conditions, at 700°C, with an initial stress of 10.0 kg/mm^2. The emphasis was on interrupted tests so that the microstructural changes taking place during creep could be observed. Helium reduced the rupture life and ductility of the alloy. It also increased the secondary creep rate and changed the failure mode from transgranular to intergranular, but did not affect the intragranular deformation mechanisms. Helium is swept into the grain boundaries by dislocation motion very early in the creep process. This increases grain-boundary sliding, as shown by separate tensile test results. The helium in the grain boundaries agglomerates into bubbles, the largest being at carbide-matrix interfaces. The effects of the sliding and the bubbles are to cause early nucleation, and subsequent rapid growth, of intergranular cracks leading to premature failure. (auth)

486 (CEA-N-1426) APPARATUS FRUIT FOR THE CONTINUOUS MEASUREMENT OF CREEP IN URANIUM. de Montpreville, Christian Thomas (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1971. 15p. (In French). Dep. NTIS (U. S. Sales Only).

An apparatus for measuring creep in metals during irradiation is described. The originality of the method by which the deformation is measured is emphasized. (France)

487 (LA-4695) INVESTIGATION OF A HIGH-DENSITY TUNGSTEN-BASE ALLOY. Sheinberg, H.; Frakes, J. T.; Riley, R. E. (Los Alamos Scientific Lab., N. Mex.). Oct 1971. Contract W-7405-eng-36. 17p. Dep. NTIS.

The effect of sintering time, temperature and atmosphere, postsintering heat treatments, tungsten particle size, and compositional variations upon the mechanical properties and structure of a 95 wt % W-3.5 wt % Ni-1.5 wt % Fe base alloy were investigated. Improvements were observed with postsintering heat treatments, fine tungsten powders, and small rhenium or chromium additions. (auth)

488 (RHEL/R-217) NON-MAGNETIC STAINLESS STEELS FOR CRYOGENIC PURPOSES. Larbalestier, D. C.; King, H. W. (Rutherford High Energy Lab., Chilton (England)). Jan 1971. 24p. Dep. NTIS (U. S. Sales Only). UK 25p.

An investigation of the magnetic properties of the austenitic stainless steels at low temperatures was made. Recommendations for the avoidance of ferromagnetism in these steels are made, with particular reference to those considered for the High Field Bubble Chamber. (auth)

489 (WARD-4210-T-3-4) STAINLESS STEEL CLADDING DEVELOPMENT. Quarterly Progress Report for the Period Ending March 31, 1971. Ray, William E. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). May 1971. Contract AT(30-1)-4210. 39p. Dep. NTIS.

Results of tests, measurements, and observations made during the report period on vacuum melted steels, except for identification of precipitates in post-stress rupture specimens, are reported. Seven long-term stress rupture tests were completed. Seven tested specimens and two control specimens were prepared in special mounts, and cathodic vacuum etched. The microstructures were evaluated for grain size and shape, and cavity distribution. Strain profile measurements were made for 17 additional post-stress rupture test specimens bringing the total number of specimens evaluated by this approach to 53. Rupture ductilities and shoulder ductilities were measured for each of these specimen and evaluated with respect to test stress and material properties. As part of the defects evaluation research, seven biaxial stress rupture tests in argon atmosphere were completed for 20 percent cold worked tubing, containing intentional defects of various sizes and orientations. An indication of a defect length effect was observed. The tubes containing numerous OD surface defects, resulting from previous repeated handling were used to test the eddy current and ultrasonic equipment and procedures to set confidence limits on the observed responses, and to compare responses by the two methods with EDM notch standards of various sizes, orientations, and locations. Twelve items from a total of 23 tubing lots and sublots, ordered for development work on stainless steel cladding have been received. Although this order is not complete, these items are sufficient to meet the needs of the defects evaluation testing. A replica procedure for internal tube surfaces has been up-graded during the report period but thus far has been applied to only a limited number of specimens. (auth)

490 (WARD-4210-T-3-7) STAINLESS STEEL CLADDING DEVELOPMENT. Quarterly Progress Report for the Period Ending June 30, 1971. Ray, William E. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Aug 1971. Contract AT(30-1)-4210. 40p. Dep. NTIS.

The final delivery of tubing ordered for defects evaluation was received and accepted, and the order was closed. Preliminary nondestructive eddy current characterization of 12 tubing lots, having various finishing steps, was completed and the effects of the variables evaluated. A total of 12 stress rupture tests in argon and one in air of defected and non-defected specimens were completed. The results were compared with the stress rupture curve previously obtained for this lot of material. Three stress rupture specimens which had failed at previously defined defects were characterized by rupture morhpology, strain profile, post-test wall thickness measurements, light microscopy, and scanning electron microscopy. A preliminary and tentative evaluation was made of the effect of longitudinal defects on rupture life, rupture ductility, local wall strain, and rupture morphology. Characterization of as-fabricated Cartech tubing was initiated using the methods employed in vacuum melted steels testing. (auth)

491 SURFACE LIFETIMES OF ALKALI METALS ON MOLYBDENUM. Scheer, Milton D.; Klein, Ralph; McKinley, John D. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys.; 55: No. 7, 3577-84(1 Oct 1971).

The surface lifetimes ($\bar{\tau}$) of all the alkali metals on a polycrystalline molybdenum surface in the temperature region 900 to 1350°K were measured. The temperature dependence followed an Arrhenius expression of the form $\bar{\tau}^0 \exp(\bar{I}/kT)$. Desorption energies ($\bar{I}$) were found to be 3.14, 2.60, 2.53, 2.31, and 2.10 eV for Li, Na, K, Rb, and Cs. The corresponding pre-exponential factors ($\bar{\tau}^0$) were 3×10^{-16}, 3×10^{-15}, 2×10^{-14}, 1×10^{-13}, and 3×10^{-13} sec. From these data, ion and neutral desorption energies were calculated using a model employing a partial surface charge for the adsorbed particle and the Schottky relation. The validity of the Schottky relation for an adsorbed alkali was supported by analysis of recently available theory of partial charges. An explanation of the variation of the pre-exponential factors is presented on the basis of relative mobility of the adsorbed species. A pre-exponential factor was calculated using a partition function for an adsorbate with mixed localized and nonlocalized character. The extremes of completely localized and completely nonlocalized adsorption led to pre-exponentials that spanned the experimental values. (auth)

492 EFFECT OF THERMAL CYCLING ON THE LONG-TERM STRENGTH OF MOLYBDENUM ALLOYS. Goronkova, A. D.; Morgunova, N. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); No. 7-8, 576-9(Jul-Aug 1970).

Translated from Metalloved. Term. Obrab. Metal.; No. 7, 28-32(Jul 1970).

Studies were made on the long-term strength of Mo alloys under constant load at constant temperature and also under constant load with cyclic changes in temperature. The variation of temperature with time in thermal cycling was rectangular. The materials investigated were vacuum-melted wrought alloys of Mo—a single-

phase alloy and a two-phase alloy hardened with carbides. The tests indicated that with cyclic changes in temperature the long-term strength decreased substantially as compared with the strength at constant temperature. The decrease depended on the maximum temperature of thermal cycling, the decrease being greatest in a certain temperature range. A critical temperature range, where the effect of thermal cycling was greatest, was observed in both cases. However, the temperature ranges differed for the two alloys. (P.C.H.)

493 DISTRIBUTION OF BORON IN THE MICROSTRUCTURE OF METALS. Krishtal, M. A.; Ivanov, L. I.; Grinberg, E. M. (Tula Polytechnical Inst., USSR). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); No. 7-8, 710-12(Jul-Aug 1970).

Translated from Metalloved. Term. Obrab. Metal.; No. 8, 74-6(Aug 1970).

The autoradiographic tracer method for studying the distribution of B in the microstructure of metals is described. The method is based on the ability of high-polymer detectors to record traces of α particles that are products of the interaction of the lighter B isotope ^{10}B with thermal neutrons. The results indicated that both in small and fairly large amounts, B is unevenly distributed in the microstructure of Fe, steel, and Mo. Being a surface-active impurity, B concentrates in the boundaries of grains and other structural and substructural defects. The bulk solubility of B in Fe is ~2 to 3×10^{-3}%. (P.C.H.)

494 MELTING CURVE OF TANTALUM UP TO 60 KILOBARS. Fateeva, N. S.; Vereshchagin, L. F. (Inst. of High Pressure Physics, Moscow). Dokl. Akad. Nauk SSSR; 197: No. 5, 1060-1(11 Apr 1971). (In Russian).

Tantalum, which contained a few tenths of a percent of niobium and melted at 3268 ± 50°K at atmospheric pressure, was used to obtain a melting curve as a function of pressure. The melting point at 60 kilobars was 3567°K, with intervening points lying on the curve which is described by $T_{mp} = 3249 + 5.3 \times 10^{-3} P$, where T is in °K, and P is measured in bars. (K.S.W.)

495 ANELASTICITY RESULTING FROM INTERACTIONS BETWEEN DISLOCATIONS AND POINT DEFECTS. Perez, J.; Peguin, P.; Fantozzi, G.; Gobin, P. (Institut National des Sciences Appliquees, Villeurbanne, France). Ann. Phys. (Paris); 5: No. 5, 303-52(Sep 1970). (In French).

The role of the interaction between dislocations and point defects in anelastic phenomena is discussed. Two principal types of experimental results are mentioned in the literature: the dependence of internal friction on the amplitude, and the temperature dependence of the internal friction spectrum. The principal theoretical models are presented and the interpretation of the experimental results using these models is reviewed: fcc metals (Cu and Au, Al) and bcc metals (refractory metals-Kosters peaks) in the case of internal friction peaks. Two particular aspects of the variation of anelasticity induced by interaction between dislocation and point defects are considered: pinning due to the migration of defects towards dislocations after cold working or irradiation, the mobility of pinning points along or perpendicular to dislocation lines. (France)

496 TITANIUM AND TITANIUM ALLOYS. Wood, R. A. (Battelle Memorial Inst., Columbus, Ohio). DMIC Rev.; 4p. (9 Sep 1970).

Recent research on Ti alloys includes work on: room temperature tensile and elevated temperature creep properties of Ti–6Al–2Sn–4Zr–6Mo alloy in section thicknesses suitable for jet engine disks; the elevated temperature tensile properties of Ti–4.5Sn–6Zr–11.5Mo; the effect of microstructure on the strength, toughness and stress-corrosion susceptibility of sheet, plate and bar of β-III alloy (Ti–4.5Sn–6Zr–11.5Mo); transmission electron microscopy, x-ray diffraction and electrical-resistivity techniques for studying the decomposition of the β phase in Ti–13V–11Cr–3Al alloy; β composition fluctuations in Ti–Cr binary alloys; stress-induced transformations in the β phase; the role of friction in fretting of Ti–6Al–4V specimens; flaw-growth characteristics of Ti–6Al–4V alloy under cryogenic and ambient proof-test conditions; and the development of a new porous Ti fiber for absorbing commercial jet aircraft noises. (Metals Abstr.)

497 RELAXATION MAXIMA IN MOLYBDENUM AND NIOBIUM SINGLE CRYSTALS PRELIMINARILY STRAINED WITH ULTRASOUND. Nikitova, G. A.; Polotskii, I. G.; Prokopenko, G. I. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: 491-3(Mar 1971). (In Russian).

Monocrystals of Mo and Nb which had been previously exposed to ultrasound were investigated by a pulse method at frequencies of 5, 10, and 30 MHz in order to determine the temperature dependence of the logarithmic decrement of vibration. Attenuation maxima of a relaxation nature were established. The latter were disposed in the same temperature range as the relaxation attenuation maxima (α-peaks) for deformed crystals of Mo and Nb. The activation energy, as determined by the shift in the maxima for a given frequency change, amounted to 0.37 eV for Mo, and 0.35 eV for Nb. The α-peak height in previously deformed monocrystals of Mo and Nb decreased under the influence of ultrasound vibrations with amplitudes of deformation of the order of 10^{-4}. (tr-auth)

498 HIGH PRESSURES IN PHYSICAL METALLURGY. Poirier, J. P.; Francois, D.; Adda, Y. (Centre d'Etudes Nucleaires, Saclay, France). Ann. Phys. (Paris); 5: No. 5, 291-302(Sep 1970). (In French).

A great number of macroscopic properties of crystals are related to the behavior of defects. The influence of pressure on these defects is reviewed. The way in which pressure affects the behavior of point defects and dislocations and consequently, diffusion, high-temperature creep, and plastic deformation was studied, as well as the effect of pressure on macroscopic defects (cracks, cavities) caused by the coalescence of lattice defects. The influence of these properties on different types of fracture is described. Cracks obtained in Be were studied using microscopy. (France)

499 RELATIONSHIPS BETWEEN CHANGES IN THE STRUCTURE AND PROPERTIES OF BERYLLIUM–ALUMINUM ALLOYS. Fridlyander, I. N.; Yatsenko, K. P.; Nekrasova, G. A.; (and others). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); No. 7-8, 599-603(Jul-Aug 1970).

Translated from Metalloved. Term. Obrab. Metal.; No. 7, 50-5(Jul 1970).

Studies were made on the effects of Mg additions on the properties and structure of Al–Be alloys. The study of changes in the mechanical properties of Al–Be and Al–Be–Mg alloys in relation to the Be concentration indicated that, together with a fairly smooth increase in strength for alloys of the Al–Be and Al–Be–Mg systems with increasing concentrations of Be, there was also a continuous but considerably sharper increase in the modulus of elasticity. The structure of the alloy with 30% Be and 5% Mg (the remainder Al) water-quenched from 420°C was a relatively uniform mixture of two phases— the α_{Al} solid solution and particles of β phase. An investigation of changes in the mechanical showed that aging, as in Al–Mg alloys, did not result in any increase in the strength characteristics, and therefore Al–Be–Mg alloys may be used commercially without heat treatment. Prolonged annealing of Al–Be and Al–Be–Mg alloys for 50 hr at temperatures up to 400°C had no substantial influence on the properties of the alloys after cooling. (P.C.H.)

500 ADSORPTION OF NITROGEN ON W(100). Adams, D. L.; Germer, L. H. (Cornell Univ., Ithaca, N. Y.). Surface Sci.; 26: No. 1, 109-24(Jun 1971).

The adsorption of nitrogen on W(100) has been studied by means of flash-desorption, mass-spectroscopy and LEED measurements. Adsorption of nitrogen at room temperature onto a clean W(100) surface produces a single binding state, corresponding to the formation of a $C(2 \times 2)$ array of nitrogen atoms; the saturation coverage is $\theta = 0.5$ monolayer of atoms. After room-temperature adsorption, the dimensions of the new diffraction features indicate a considerable disorder in the adsorbate structure. Markedly different behavior is found for different ranges of coverage. In the range $\theta = 0$ to 0.2, nitrogen is adsorbed with sticking probability of 0.32 to form islands elongated in the surface ⟨11⟩ directions. Because of the substrate symmetry there are two orthogonal island orientations, and for each orientation there are two anti-phase placements. At these low coverages, $\theta < 0.2$, heating to temperatures below 1100°K (where nitrogen begins to desorb) produces no change of LEED pattern, indicating that inter-island coalescence does not occur. At $\theta > 0.2$ the sticking probability falls as interference between islands deactivates the hitherto active sites at island ends. In the range $\theta = 0.3$ to 0.4, annealing the crystal to 900°K after room temperature adsorption results in a poorly ordered superstructure consisting of an array of out-of-phase islands. In the range $\theta = 0.4$ to 0.5, annealing to 900°K causes inter-island coalescence, giving large domains of perfect $C(2 \times 2)$ structure. The nature of the adsorbate–substrate binding is briefly considered. (auth)

501 ADSORPTION STUDIES IN THE FIELD ION MICROSCOPE WITH ARGON IMAGING. Lewis, R. T.; Gomer, R. (Univ. of Chicago). Surface Sci.; 26: No. 1, 197-229(Jun 1971).

The adsorption of oxygen, CO, CH_4, and H_2 on tungsten has been investigated by means of Ar ion microscopy, with the aid of an internal channel plate multiplier. The results indicate that CO, H, and probably O are not themselves visible in Ar imaging, while CH_4 may be under some conditions. CO adsorption at 78

and 300°K does not seem to cause surface reconstruction. However in the presence of Ar, field-induced corrosion sets in at $F > 2.0$ V/Å and becomes rapid at 3 V/Å, where it causes considerable surface disorder. In the case of CH_4, corrosion also occurs at <3 V/Å in the presence of Ar. Oxygen at 78°K and small coverages seem to cause little reconstruction if any; rather the visibility of substrate atoms becomes modified. For coverages close to a monolayer the image contrast vanishes almost totally so that it is difficult to draw unequivocal conclusions. There is some evidence that W–O complexes form and stick out above the surface, but this seems to be the exception rather than the rule. Field desorption in the presence of Ar sets in at 2.6 V/Å and leads to desorption of W as well as of O atoms. In all cases, the (110) plane exhibits unusual stability and seems unreconstructed in adsorption and only slightly affected by corrosion; it is not possible to see whether changes occur which leave this surface very densely packed, and hence are unresolved, but gross reconstruction and disorder on (110) can be ruled out by the present experiments. H_2 is invisible in Ar imaging and does not affect the surface in any noticeable way. (auth)

502 KINETICS OF DECOMPOSITION OF PENTANE AT 10^{-5} TO 10^{-1} TORR ON SURFACE OF TANTALUM AND Ta_2C AND TaC BETWEEN 1300 AND 2300K. Tardif, A.; Michel, J. M.; Wach, J. (CNRS, Nancy). Surface Sci.; 26: No. 1, 255-68(Jun 1971). (In French).

On the three surfaces Ta, Ta_2C and TaC_x, the decomposition reaction of n-pentane is of first order for pressures $\lesssim 10^{-4}$ torr and presents an activation energy of 2 to 5 kcal/mole. Chemisorbed oxygen has a strong contaminant effect which is very persistent. The discontinuity in the speed of the reaction on Ta_2C, observed around 1700°K, is attributed to the eutectoidal reaction $Ta_2C \rightarrow Ta + TaC$. The speed of reaction on TaC_x diminishes linearly with x and tends to zero when x approaches unity. It is shown that this result can be explained by a chemisorption model which implies three successive atomic layers of the substrate. (auth)

503 CRYSTALLOGRAPHIC ANISOTROPIES IN CONDENSATION: N_2 ON (110)W. Tamm, P. W.; Schmidt, L. D. (Univ. of Minnesota, Minneapolis). Surface Sci.; 26: No. 1, 286-96(Jun 1971).

Condensation and desorption kinetics and binding states of nitrogen on the (110) plane of W are studied by flash desorption mass spectrometry. It is found that $\sim 9 \times 10^{13}$ molecules cm^{-2} of nitrogen are adsorbed in a single major atomic state with a desorption activation energy of 79 kcal $mole^{-1}$. The sticking coefficient s in this state is observed to be very low, $s_0 = 0.005$, and decrease rapidly with increasing coverage. It is found that $s(\theta)$ can be fit fairly well by an expression of the form $s = s_0(1-\theta)^2$, indicating that two vacant sites are required for condensation. It is suggested that this state, occupying one-eighth of the geometric sites on the (110) plane, is actually associated with perfect sites on this plane and that the properties observed are due to the multiple bonding capabilities of the nitrogen atom. (auth)

504 LEED STUDY OF STRUCTURES PRODUCED BY H_2 ON W(100). Yonehara, K.; Schmidt, L. D. (Univ. of Minnesota, Minneapolis). Surface Sci.; 25: No. 2, 238-60(Apr 1971).

The Leed structures resulting from hydrogen adsorption on (100) W are studied as functions of hydrogen coverage and surface temperature for temperatures above 78°K. Coverages are determined by flash desorption. Diffraction beam intensity profiles are also examined. It is found that at 300°K the maximum intensity of the $c(2 \times 2)$ pattern occurs at 0.16 monolayer and that these beams vanish at a coverage of 0.35. Splitting of the half-order beams begins at the maximum intensity and attains a maximum distance of $\frac{1}{4}$ of the lattice spacing at both 300 and 195°K. At 78°K, half-order beams are observed, but no splitting occurs. When a surface which has been heated to ~2500°K is allowed to cool below 300°K in ultrahigh vacuum, sharp and intense beams characteristic of a $c(2 \times 2)$ configuration are observed even though no more than 0.01 monolayer of adsorbed gases can be detected by flash desorption. The intensity of these extra beams decreases with increasing temperature and appears to be a function of the crystal temperature alone. Treatment of the crystal in oxygen reduces the intensity of this structure on the clean surface, but after heating briefly in hydrogen, the $c(2 \times 2)$ pattern is again observed on the clean surface. It is suggested that this structure on the "clean" surface may be due to structural rearrangement of tungsten or an adsorbed state of hydrogen which goes into solution upon heating. Since hydrogen solution is endothermic its solubility decreases with decreasing temperature, and hydrogen may therefore migrate to the surface upon cooling and accumulate there. The implications of these results in regard to the adsorption states of hydrogen on tungsten are discussed. (auth)

505 SELF DIFFUSION OF HYDROGEN IN TRANSITION-METAL HYDRIDES. Khodosov, E. F. (Physical-Technical Inst., Kiev). Sov. Phys.-Cryst. (Engl. Transl.): 16: No. 2, 369-72(Sep-Oct 1971).

Translated from Kristallografiya; 16: No. 2, 442-5(Mar-Apr 1971).

Data on self-diffusion, structure, and position of hydrogen in hydrides of Ti, Zr, Y, Nb, Ta, and Pd are tabulated from the literature. Transitions of hydrogen, both reversible and irreversible, between the tetrahedral and octahedral interstices are discussed, and their graph representation in the form of potential wells is given. (D.L.C.)

506 SURFACE THERMAL EXPANSION FOR Cr(100) AND Mo(100) SINGLE CRYSTALS. Wilson, J. M. (Cambridge Univ., Eng.); Bastow, T. J. Surface Sci.; 26: No. 2, 461-70(Jul 1971).

The thermal expansion coefficient, α_s, for (100) surfaces of Mo and Cr has been estimated by Leed. Measurements of energy shifts of the (00) intensity peaks with temperature give values between two and three times the average bulk value over the same temperature range. These results are consistent with large mean square amplitudes of vibration when discussed in terms of the Grueneisen relation. Some simple ideas concerning the interatomic potential of a surface atom are developed which agree with our measurements. (auth)

507 SURFACE DEBYE–WALLER FACTORS FOR Cr(100) AND Mo(100). Tabor, D.; Wilson, J. M.; Bastow, T. J. (Cambridge Univ., Eng.). Surface Sci.; 26: No. 2, 471-89(Jul 1971).

Using low-energy electron diffraction (LEED), Debye–Waller factors were measured for Cr(100) and Mo(100) surfaces at near normal incidence. It was found that the derived effective Debye temperature as a function of electron energy fluctuates about a curve which increases smoothly with energy and saturates at the bulk value of Debye temperature. The Debye temperatures measured on peaks near the Bragg voltage are about 18 to 25% higher than those measured on peaks near half-order Bragg voltages. Some of the results are interpreted in terms of a variation in absorption coefficient with energy and also in terms of multiple diffraction. (auth)

508 ADSORPTION OF OXYGEN ON MOLYBDENUM(111): EFFECT OF TRACE IMPURITIES. Lambert, R. M.; Linnett, J. W.; Schwarz, J. A. (Cambridge Univ., Eng.). Surface Sci.; 26: No. 2, 572-86(Jul 1971).

The work reported was directed towards studying the room-temperature interaction of oxygen with molybdenum(111) using the techniques of low-energy electron diffraction (LEED), Auger-electron spectroscopy, and flash-desorption mass spectrometry. Exposure of the surface at room temperature to oxygen reduced the intensity of the LEED patterns and increased the oxygen Auger signal at 516 V. These two effects correlated and gave an initial sticking coefficient of $\approx \frac{1}{3}$. Using the LEED and Auger data, it is shown that $\frac{2}{3}$ of the surface was rendered inactive by impurity atoms. For a sticking coefficient defined in terms of uncontaminated surface area, this result would indicate unit probability for chemisorption of oxygen on the molybdenum(111) surface at room temperature. The only species observed to desorb upon rapid heating of the sample was CO. There was a direct correspondence between the extent of oxygen adsorption and the complexity of the CO flash desorption spectrum. (auth)

509 COMPARATIVE DUCTILITY OF MONO AND POLYCRYSTALLINE URANIUM IN THE α AND β PHASE FROM ISOTHERMAL AND ANISOTHERMAL CREEP MEASUREMENTS AT TEMPERATURES IN THE VICINITY OF THE $\alpha \rightarrow \beta$ PHASE TRANSFORMATION. Collot, Jean; Cizeron, Georges; Lacombe, Paul (Ecole Nationale Superieure des Mines, Paris). Compt. Rend., Ser. C; 273: No. 4, 328-31(26 Jul 1971). (In French).

The respective ductilities of the α and β phases of mono- and polycrystalline uranium at temperatures in the vicinity of the $\alpha \rightleftharpoons \beta$ phase transformation were compared. Isothermal and anisothermal creep tests led to a hypothesis on the effects of β grain size, resulting from the $\alpha \rightleftharpoons \beta$ phase transformation, on the comparative ductilities of the two phases, and to considerations on the validity of the relation between the creep velocity and self-diffusion coefficients. (France)

510 PROPERTIES OF INCONEL ALLOY 706. Eiselstein, H. L. Tech. Rep. No. C70-9.5. Metals Park, Ohio; American Society for Metals (1970). 21p. $3.00.

Inconel alloy 706 is a new precipitation-hardening alloy soft enough to be processed in conventional hot working equipment yet yield a product of high strength. From results of a development program which was set up to evaluate the effects of alloy elements on properties and fabricability, a composition was established with high mechanical properties to a service temperature of 1200°F. The alloy composition is conservative in its consumption of the more expensive elements, Ni, Nb and Mo. Heat treatments necessary to bring out the optimum combination of properties and fabricability are given. (Metals Abstr.)

511 INTERGRANULAR BRITTLENESS OF MOLYBDENUM BICRYSTALS USING A SYMMETRIC TRANSVERSE TEST ABOUT THE [001] AXIS. Kobylanski, Andrzej; Goux, Claude (Ecole Nationale Superieure des Mines, Saint-Etienne, France). Compt. Rend., Ser. C; 272: No. 24, 1937-40(14 June 1971). (In French).

The systematic study of the intergranular brittleness of molybdenum was effected on bicrystals with a symmetric [001] axis using the transverse test. The grain boundaries with a weak disorientation were much less brittle than those having a strong disorientation and the rupture profiles examined in microfractography were quite different. In the case of grain boundaries with a weak disorientation, the behavior of the grain boundaries near the (001) cleavage planes was very different from those near to the (011) planes. (France)

512 STUDY OF THE DECOMPOSITION OF SUPERSATURATED SOLID SOLUTIONS OF TUNGSTEN IN COBALT BY A THERMOMAGNETIC METHOD. Efimova, T. V.; Polotnyuk, V. V.; Shmatko, O. A. Metallofizika; No. 32, 56-9(1970). (In Russian).

The decomposition of the supersaturated solution of W in Co in Co–3–13 at. % W alloys was studied by a thermomagnetic method, the Curie point of the corresponding alloys being plotted as a function of their composition. In a Co–13 at. % W alloy heat-treated at 700°C, two Curie points appeared to exist. Analysis of the thermomagnetic curves gave a clear picture of the kinetic changes in the phase composition of the alloys and of the amount of W passing into the precipitated phases. (Metals Abstr.)

513 EFFECT OF CERIUM ON THE PHASE COMPOSITION AND PROPERTIES OF NIOBIUM–ALUMINUM ALLOYS. Svechnikov, V. N.; Pan, V. M.; Latysheva, V. I. Metallofizika; No. 32, 28-33(1970). (In Russian).

The effect of Ce, La, Y, and Pr on the mechanical properties of Nb and Nb–Al alloys (as well as their phase composition) was studied. Alloying with Ce, La, Y, or Pr almost halved the hardness of metallic Nb, with a corresponding effect on its rolling characteristics. Isothermal cross sections of the Nb–Al–Ce system plotted at 1100–1600°C revealed a substantial solubility of Ce in the β- and σ-phases (7.5 and 10 at. %, respectively at 1100°C). The Ce solubility fell with increasing temperature. The hardness of the β-phase fell monotonically from 950 to 600 kg/mm^2 with increasing Ce content. (Metals Abstr.)

514 EFFECT OF ZIRCONIUM ON THE HIGH-TEMPERATURE HARDNESS AND HEAT RESISTANCE OF IRON–CHROMIUM ALLOYS. Svechnikov, V. N.; Spektor, A. Ts. (Inst. of Metal Physics, Kiev). Metallofizika; No. 29, 94-8(1970). (In Russian).

The effect of Zr on the high-temperature hardness and heat-resistance of Fe, Cr, and Fe–Cr alloys (including those of the $ZrCr_2$–$ZrFe_2$ type) was studied at temperatures up to 1000°C. Alloying the Fe–Cr samples with Zr, in particular, led to a sharp increase in hardness, especially for alloys containing Cr 1–11%. For constant Zr contents, the maximum hardness occurred for alloys containing Fe 20%. At 800 to 1000°C, the greatest hot hardness was obtained for samples with 20% Fe and 20 to 35% Zr. From the practical point of view, the best combination of properties was obtained for 20 to 30% and 10–20% Zr. (Metals Abstr.)

515 EFFECT OF ALLOYING ELEMENTS ON THE ELASTIC PROPERTIES OF CHROMIUM. Kurdyumova, G. G.; Mil'man, Yu. V.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 29, 101-7(1970). (In Russian).

The effects of Os, Re, Fe, Co, and Mn on the lattice parameters and elastic properties of Cr were studied. Os and Re greatly increase the lattice parameters of Cr; Fe, and Co reduce them, while Mn has little effect, in general agreement with the Vegard law. There is a close correlation between the elastic moduli of the Cr alloys and the corresponding cold-shortness temperature, increasing elastic moduli being accompanied by a fall in the cold-shortness threshold. These results are discussed from the point of view of the electron structures of the constituents of the alloys. (Metals Abstr.)

516 CHANGE IN THE STRUCTURE AND PROPERTIES OF MOLYBDENUM AFTER HEATING AT HIGH TEMPERATURES. Girshov, V. L.; Drachinskii, A. S.; Kaverina, S. N.; Pisarenko, V. A.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 30, 42-9(1970). (In Russian).

Changes in the structure of Mo alloys containing traces of Ti, Zr, and C after high-temperature (~2000°C) heat treatment were studied. The heat treatment was carried out either in a conventional vacuum furnace and subsequently cooling at 1°C/sec or else by the direct passage of an electric current with a heating rate of 150 and a cooling rate of 200°C/sec. The samples heated by the direct passage of an electric current had considerably greater strength and ductility (50 to 100% increment) than the furnace-heated samples. In some cases heat treatment was followed by aging processes. (Metals Abstr.)

517 KINETICS OF THE FORMATION AND GROWTH OF RECRYSTALLIZATION CENTERS IN PURE AND SLIGHTLY ALLOYED NICKEL SINGLE CRYSTALS. Belyakova, M. N.; Zasimchuk, E. E. (Inst. of Metal Physics, Kiev). Metallofizika; No. 30, 118-21(1970). (In Russian).

The kinetic characteristics of recrystallization processes taking place in severely worked samples of electron-beam-refined Ni and Ni–Mo–Ti alloys rolled in the (111) plane were studied, with special reference to the mechanisms responsible for the creation of crystallization centers. The impurities dissolved in the slightly alloyed Ni crystals sharply retard both the formation and the growth of the recrystallization centers. The reasons for this effect are discussed on the basis of general nucleation theory. (Metals Abstr.)

518 INTERRELATION BETWEEN POLYGONIZATION PROCESSES AND RECRYSTALLIZATION DURING ANNEALING OF WORKED MOLYBDENUM SINGLE CRYSTALS. Zasimchuk, E. E.; Maksimenko, E. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 30, 121-8(1970). (In Russian).

Structural changes taking place during the annealing of Mo single-crystal plates after rolling in the (100) and (110) planes were studied by x-ray diffraction. In the absence of local regions of overloading, recrystallization was prevented either by adopting a step-by-step mode of heat treatment or else by prolonged annealing at a temperature below 0.3 T_m (T_m = m.p. in °K), designed to create a cellular structure in the material. On increasing the rolling temperature, the formation of recrystallization centers in nonuniformly stressed regions tended to intensify. (Metals Abstr.)

519 REACTION OF HYDROGEN AND DEUTERIUM WITH NIOBIUM–ZIRCONIUM ALLOYS AT 900°C. Charlot, L. A.; Westerman, R. E. (Battelle-Northwest, Richland, Wash.). J. Nucl. Mater.; 41: No. 2, 227-30(Nov 1971).

A study was undertaken to determine the extent to which zirconium alloy additions might affect the normally rapid rates of diffusion of hydrogen and deuterium through niobium at a temperature near that anticipated for the vacuum wall of an operating thermonuclear reactor. Results of the study do not indicate any unusual high-temperature absorption or desorption kinetics of hydrogen or deuterium by niobium alloys caused by the presence of zirconium. It was felt that the experimental techniques employed were not able to discriminate between individual alloys, or, for that matter, between hydrogen or deuterium, hence the exclusive use of data boundaries instead of data points. It is certain that differences in reaction kinetics will be caused by the presence of alloy elements such as zirconium and yttrium, however, it remains for a more detailed, extensive study to identify and quantify these differences. (auth)

520 EFFECT OF HYDROGEN ON THE LOW TEMPERATURE INTERNAL FRICTION OF A NIOBIUM SINGLE CRYSTAL. Buck, O. (North American Rockwell Science Center, Thousand Oaks, Calif.); Thompson, D. O.; Wert, C. A. J. Phys. Chem. Solids; 32: No. 10, 2331-44(Oct 1971).

The internal friction and Young's modulus of a hydrogen doped niobium single crystal were measured in the temperature range 20 to 370°K. Nucleation of niobium hydrides is indicated by the growth of an internal friction maximum. The height of the internal friction maximum is proportional to the hydrogen concentration and it shifts progressively to higher temperatures with increasing hydrogen concentration. The activation energy of the peak was found to be about 0.27 eV. From the experimental correlation between temperature and hydrogen concentration at which the peak forms it is possible to deduce the $\alpha/\alpha + \beta$ solvus. The solvus yields a heat of solution of about 0.12 eV, in agreement with other measurements. Deuterium doped niobium did not yield significantly different results from the ones obtained with hydrogen. (auth)

521 EXPERIMENTAL CONFIRMATION OF THE EXPECTED SURFACE TENSION VERSUS TEMPERATURE FUNCTION OF LIQUID SODIUM AT HIGH TEMPERATURES. Grosse, Aristid V. (Franklin Inst., Philadelphia). Rev. Int. Hautes Temp. Refract.; 8: No. 1, 11-14(Jan-Mar 1971).

The validity of Van der Waals equation, $\sigma_T = \sigma_0 (1 - T/Tc)^n$, in the case of the alkali metals is considered, and the results obtained by different workers are discussed. (auth) (France)

522 CONCERNING THE ADSORPTIVE CAPABILITY OF TRANSITION METALS. Podchernyaeva, I. A.; Fomenko, V. S. (Kiev Polytechnic Inst. Inst. of Problems of Science of Materials, Kiev). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 14: No. 1, 56-60(1971). (In Russian).

Results of investigations are presented to show that the bond energy of adsorbing systems involving fixed adsorbents such as W and adsorbates such as Cs, Ba, La, or Tn increases with increasing valence electrons of the adsorbate. The bond energy of adsorbing systems such as W–rare earths, shows a relation to the atomic number of the adsorbent. The relations of energy change of transition metal adsorbing systems and energy changes by alkaline earth, alkali metal, and rare earth adsorbates were established. A model is offered in which the adsorptive heteropolar bond present is functional in a localized condensed state. (tr-auth)

523 CRITICAL RECRYSTALLIZATION OF COLD WORKING OF ORIENTED MONOCRYSTALS OF Nb, Mo, AND W DEFORMED BY COMPRESSION. Kobylanski, A.; Levy, J.; Goux, C. (Ecole Nationale Superieure des Mines, Saint-Etienne, France). Compt. Rend., Ser. C; 273: No. 2, 128-30(12 Jul 1971). (In French).

The critical cold-working rates of germination and growth were determined in refractory bcc metals: they are distinct for Nb (and probably for Ta) and practically identical for W and Mo; these two metals do not recrystallize after compression along the [001] axis. (France)

524 DEFORMATION AND CRACKING OF Zr–Cu FUEL CLADS IN CO_2. RELATION WITH THE OPERATIONAL BEHAVIOR. Frenkel, J. M.; Weisz, M. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 157, 61-8(Mar 1971). (In French).

The behavior of a Zr–Cu clad fuel element was studied. The diffusion of oxygen from zirconia leads to a decrease in the ductility of the cladding and especially to the cracking of an oxygen-rich layer at the time of thermal cycling. The mechanism of this cracking was established together with its overall effects on the fuel. After treatment of Zr–Cu cladding in the β phase, the tendency towards cracking under working conditions is eliminated, owing to the good creep resistance introduced by this heat treatment. With a β-tempered ZrCu cladding, it is thus possible to obtain very advantageous burnup values: about 15,000 MWJ/t at cladding temperatures of the order of 600°C. (France)

525 KINETICS OF PRIMARY, SECONDARY, AND COLLECTIVE RECRYSTALLIZATION IN TUNGSTEN WIRE. Zasimchuk, E. E.; Isaichev, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 31, 59-66(1970). (In Russian).

The kinetics and texture of primary, secondary, and collective recrystallization in W wires of various compositions were studied by metallographic analysis and x-ray diffraction at 900 to 2300°C. The composition of the wire (proportion of impurities) has a marked effect on the grain growth occurring at 1900 to 2300°C after the completion of primary recrystallization. The kinetic laws governing the processes differ little from those corresponding to massive W samples and thin foils. The axial texture of all types of wire studied lay along the [110] direction both before and after primary recrystallization. A [211] component also appeared after secondary recrystallization. (Metals Abstr.)

526 KINETICS OF THE GROWTH OF SUBGRAINS IN THE POLYGONIZATION OF WORKED TUNGSTEN. Zasimchuk, E. E.; Maksimenko, E. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 31, 66-70(1970). (In Russian).

Subgrain growth in W single crystals oriented in the (100) plane was studied by metallographic analysis and x-ray diffraction after rolling in the [110] direction and subsequently annealing in order to promote polygonization. A two-crystal spectrometer was used for the x-ray analysis. The size-distribution curves of the subgrains derived from the experiments indicated that all the subgrains coarsened substantially with increasing period of isothermal annealing, while their absolute number declined. The growth of the subgrains apparently took place by way of paired coalescence. (Metals Abstr.)

527 EFFECT OF WORKING ON THE DAMPING OF ULTRASOUND IN TUNGSTEN SINGLE CRYSTALS. Mordyuk, N. S. (Inst. of Metal Physics, Kiev). Metallofizika; No. 31, 114-17(1970). (In Russian).

The effect of preliminary working on the attenuation of ultrasound in W single crystals was studied. The curve relating ultrasound attenuation to the degree of deformation exhibited a sharp maximum associated with an increase in the density of the material and a change in the length of the dislocation loops. On increasing the degree of deformation, the microhardness of the single crystals also increased. The curve representing the temperature dependence of the attenuation coefficient also exhibited a maximum, which moved along the temperature axis as the frequency of the ultrasound varied. The activation energy of the maximum equaled 0.3 eV. (Metals Abstr.)

528 CRYSTALLOGRAPHIC CHANGES IN WORK-HARDENED SURFACE LAYERS OF TUNGSTEN, MOLYBDENUM, AND NIOBIUM ON THERMAL CYCLING. Kozyrskii, O. I.; Tikhonov, L. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 31, 117-21(1970). (In Russian).

Changes taking place in the crystal structure of the thin surface layers of W, Nb, and Mo samples, initially work-hardened by grinding, on subjection to various forms of thermal cycling were studied to a depth of approximately 5 μm by x-ray diffraction, and the results were compared with analogous existing data relating to fcc metals. Thus the work-hardened layers softened rapidly under thermal cycling of the order of 700 to 1200°C, the general laws being much the same in both bcc and fcc metals. No effects of oxidation appeared to be involved. (Metals Abstr.)

Structure and Phase Studies

Refer also to abstract 616.

529 (CONF-710916-1) TRANSMISSION AND SCANNING ELECTRON MICROSCOPE OBSERVATIONS OF NIOBIUM–HAFNIUM ALLOYS. Carpenter, R. W. (Oak Ridge National Lab., Tenn.). [1971]. 11p. Dep. NTIS.

From fifth international materials symposium; Berkeley, Calif. (13 Sep 1971).

Experimental observations showed that the fracture morphology in heat-treated Nb–Hf alloys, which were homogenized and quenched, underaged, overaged, and aged to maximum hardness at 600°C, was generally the same. Each fracture examined contained areas of transgranular shear and grain boundary separation. Both areas proved to be composed of small rough cups with shear lips, with the grain boundary separations on a finer scale. On specimens where the grain boundary precipitate was prominent enough to be clearly seen on the fracture surface, it was observed to be quite ductile. The large differences in fracture behavior found were macroscopic in nature. Accommodation strains at triple points were obvious locations for fracture nuclei that should grow rapidly under the influence of large hydrostatic tension. The hydrostatic tensile stress was 100,000 psi for specimens aged to near maximum strength. It was concluded that this high level of induced stress is the principal reason for the observed minimum in elongation and reduction in area. (P.C.H.)

530 (ORNL-TM-3494) ANNEALING OF VOIDS IN ALUMINUM. Jostsons, A.; Long, E. L. Jr.; Stiegler, J. O.; Farrell, K.; Braski, D. N. (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 22p. (CONF-710601-14). Dep. NTIS.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

The activation energy for annealing of voids in neutron-irradiated 1100 grade aluminum was determined from measurements of density recovery in bulk specimens to be 1.7 ± 0.2 eV, which is significantly higher than 1.3 eV, the activation energy for self diffusion. Trapping of vacancies by neighboring voids as well as by transmutation-produced silicon is used to explain this apparent discrepancy. In high-purity aluminum containing a large volume of voids, significant void coarsening occurred during annealing. When electrolytically thinned foils were annealed the vacancies from the shrinking voids condensed at preferred sites at the oxide-metal interface. There was a wide variation in shrinkage rates for voids of a given size. No evidence was found for enhanced shrinkage of voids located on dislocations, nor is there any reason to believe that the voids may be hydrogen filled. (auth)

531 (ORNL-tr-2517) PHASE DIAGRAM OF THE SYSTEM NEODYMIUM–BISMUTH. Kobzenko, G. F.; Chornogorenko, V. B. Translated for Oak Ridge National Lab., Tenn., from Dopov. Akad. Nauk Ukr. RSR, Ser. A; 32: No. 10, 945-8(Oct 1970). 4p. Dep. NTIS.

Alloys prepared in the arc furnace were investigated by the methods of thermal x-ray crystal and metallographic analyses and the phase equilibrium diagram of the system Nd–Bi was

plotted. Solutions with a base of Bi, Nd, and four chemical compounds, Nd_3Bi, Nd_4Bi_3, NdBi, $NdBi_2$, were phase components of the alloys. The alloys may undergo six non-variant transformations depending on the composition. (auth)

532 (ORNL-tr-2529) DISLOCATION STRUCTURE OF DEFORMED TANTALUM BY ELECTRON MICROSCOPY. Takeyama, Taro; Takahashi, Heishichiro. Translated for Oak Ridge National Lab., Tenn., from Hokkaido Daigaku Kogakubu Kenkyu Hokoku; 48: 173-85(1968). 13p. Dep. NTIS.

Changes in the structure of commercial polycrystalline Ta corresponding to various deformations as a function of the stress-strain curve for tensile deformation were directly observed with the electron microscopy in specimens in which the impurity was precipitated by furnace cooling and in specimens in which the solute was maintained in solid solution by quenching. Special attention was given to the influence of the precipitated solute on the formation of dislocations, dislocation interaction, and formation of a cell structure, and the difference in the two specimens was made clear. Many oxide precipitates were observed in the furnace-cooled specimen; these acted as the dislocation sources to produce dislocation loops and helical dislocations. In the quenched specimen, the distribution of dislocations was homogeneous up to high degrees of deformation, and the formation of a cell structure was delayed. (P.C.H.)

533 (ORNL-tr-2530) RECOVERY AND RECRYSTALLIZATION OF TANTALUM. Takeyama, Taro; Takahashi, Heishichiro. Translated for Oak Ridge National Lab., Tenn., from Hokkaido Daigaku Kogakubu Kenkyu Hokoku; 48: 187-200(1968). 13p. Dep. NTIS.

The processes of recovery and recrystallization were studied on polycrystalline tantalum by means of a transmission electron microscope. The dislocation density decreased continuously during annealing and at the same time dislocations were rearranged into a stress-free stable network. Thus the cell structures changed to subgrains during recovery. Isolated initial recrystallized grains were nucleated in small subgrains close to an old grain boundary and the growth of the initial recrystallized grain can be explained by the coalescence model. This recrystallization phenomenon may be prevented by pre-heat treatment to release the stored energy. (auth)

534 ISOTHERMAL TRANSFORMATION CHARACTERISTIC OF METASTABLE BETA-TYPE TITANIUM ALLOYS. Miyagi, Masakazu; Shin, Shigeo (Industrial Research Inst., Osaka). J. Jap. Inst. Metals; 35: No. 7, 716-22(Jul 1971). (In Japanese).

For the purpose of obtaining more detailed information on the phase transformation of metastable beta-type titanium alloys, the phase changes of Ti-Fe, Ti-Cr, Ti-Mn and Ti-Mo binary alloys during isothermal transformation were investigated by means of the microscopic observation and x-ray diffraction. It was found that before the precipitation of the alpha phase, an unusual microstructure developed in the specimens which were held for a short time at a given higher temperature prior to quenching. This unusual microstructure seemed to be caused by subgrain boundaries, etch pits, and titanium hydride. In the TTT diagrams obtained it was found that the starts of the beta-to-alpha and the beta-to-omega reactions shifted towards longer time and lower temperature as the solute concentration increased. In each alloy system, the beta-to-alpha and the beta-to-omega transformations were observed. However, the beta-to-low concentration beta transformation below about 300° ~ 250°C, reported by Harmon et al, was not observed. In the specimens isothermally transformed above about 600°C the alpha phase precipitated predominantly at the grain boundaries, while in the specimens transformed below about 550°C the alpha phase precipitated in the grains. In analyses of TTT diagrams of the alloys which have an equal atomic concentration, it was found that the rate of precipitation decreased in the order of Ti-Cr, Ti-Fe, Ti-Mn and Ti-Mo alloys. This did not coincide with the order of diffusion rate in the beta-titanium. In the case of eutectoid type alloy, referring to the phase diagrams of such binary alloys, it was concluded that the rate of precipitation, increased when the eutectoid temperature was rising or the eutectoid composition was falling. (auth)

535 INFLUENCE OF MOLYBDENUM STRUCTURES ON THE DIFFUSION OF NICKEL AND ZIRCONIUM. Borisov, E. V.; Gruzin, P. L.; Zemskii, S. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). pp 61-5 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Diffusion of Ni and Zr in Mo at 1100 to 1300°C was measured using ^{63}Ni and ^{95}Zr tracers. Resulting data are presented and discussed. (J.R.D.)

536 STRUCTURE OF TUNGSTEN-CONTAINING IRON POWDERS PREPARED BY A CHEMICOTHERMAL TREATMENT PROCESS. Radomysel'skii, I. D.; Negoda, G. P.; Gorban, G. T. (Inst. of Materials Science, Kiev). pp 114-16 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Results of the investigation demonstrated that the alloying of iron powder with tungsten by the method of thermal diffusion impregnation from point sources leads to the formation of definite alloys. The structure of the alloy particles is consistent with the iron-tungsten constitution diagram. (auth)

537 TIME/TEMPERATURE/TRANSFORMATION CHARACTERISTICS OF URANIUM-CHROMIUM ALLOYS. Burke, J. (University Coll., Swansea, Eng.); Evans, M. A. J. Inst. Metals; 99: 315-18(Oct 1971).

The isothermal $\beta \rightarrow \alpha$ phase transformation in a uranium-1% chromium alloy was studied by resistivity measurements and metallographic study after quenching from 700 to 740°C. This was supplemented by transmission electron microscope observations on a uranium-½% chromium alloy. The results confirmed earlier conclusions that the TTT diagram comprised three C-curves, the activation energies of which were ~70, 45, and 22 kcal/mole, respectively. Reaction in C_1 produced α-uranium with a dispersion of chromium particles and in C_2 acicular, heavily dislocated α-uranium. (UK) (auth)

538 INFLUENCE OF TITANIUM AND BORON ON THE STRUCTURE OF ALUMINUM-MAGNESIUM AND ALUMINUM-MANGANESE ALLOYS. Biedron, Kazimierz. Rudy Metale Niezelaz.; 16: No. 7, 336-40(Jul 1971). (In Polish).

After an outline of the theoretical principles of structure refining of aluminum alloys by means of artificial nucleation with transition elements, in particular titanium and boron, results are presented on tests carried out to determine the influence of titanium and boron additions on the refinement of the macrostructure in cast ingots. Modifiers showing best results in refinement of the primary structure are given. (auth)

539 X-RAY INVESTIGATION OF RECOVERY AND AGING IN LOW-ALLOY SHEET MOLYBDENUM. Evstyukhin, A. I.; Perlovich, Yu. A. (Moscow Engineering-Physics Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); No. 7-8, 580-2(Jul-Aug 1970).

Translated from Metalloved. Term. Obrab. Metal.; No. 7, 32-4(Jul 1970).

The intensity of x-ray reflections was measured as a function of annealing time at 1300°C for grains with different orientations in samples of sheet Mo. Grains with RP (111) had a higher rate of recovery and growth of regions of perfect lattice than grains with RP (001). Carbides were precipitated in RP (111) grains earlier and in a shorter time than in RP (001) grains, which agreed with data on the cold hardening and growth rates of these grains. X-ray analysis showed that recrystallization of RP (111) grains occurred earlier. (auth)

540 METALLOGRAPHIC INVESTIGATION OF MOLYBDENUM DEFORMED IN TENSION AT 1000 TO 1400°C. Lakhtin, Yu. M.; Kogan, Ya. D. (Moscow Highway Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); No. 7-8, 572-5(Jul-Aug 1970).

Translated from Metalloved. Term. Obrab. Metal.; No. 7, 25-7(Jul 1970).

The microstructure of Mo alloy MLT was examined metallographically in the recrystallized and nitrided conditions after creep tests at 1000 to 1400°C. Deformation of the recrystallized Mo occurred by means of slip within the grains and plasticity of the boundary areas. Deformation of the nitrided material occurred without visible branching or straight slip traces in the grains and was due to plasticity in the boundary areas. Both the nitrided and unnitrided material failed in the grain boundaries in creep tests. (P.C.H.)

541 COMMENTS ON R.F. SPUTTERED TANTALUM FILMS DEPOSITED IN AN OXYGEN DOPED ATMOSPHERE. Westwood, W. D.; Livermore, F. C. (Bell Canada Northern Electric Research Ltd., Ottawa). Thin Solid Films; 8: No. 1, R1-3(Jul 1971).

P. N. Baker (Thin Solid Films, 6: R57(1970)) reported the formation of bcc Ta by rf sputtering in Ar containing >4% O_2. It is pointed out that Baker may have misinterpreted his x-ray diffraction data, and that his films are really β-Ta. The effects of water vapor in the sputtering atmosphere are discussed. A reply by P. N. Baker is included. (D.L.C.)

542 PHASES OBSERVED IN OXYGEN-REACTIVE SPUTTERING OF TANTALUM. Feinstein, L. G. (Bell Telephone

Labs., Allentown, Pa.). Appl. Phys. Lett.; 19: No. 5, 137-8 (1 Sep 1971).

Ta films were deposited by dc diode sputtering in Ar–O_2. The crystalline structure of the deposited films was investigated by wide-film Debye–Scherrer x-ray diffraction. Films were β–Ta at low O_2 partial pressures, passing through a crystalline suboxide to the bcc phase with increasing O_2 content. The results contradict recent suggestions that β–Ta is formed to accommodate higher impurity levels. (auth)

543 METALLURGICAL STUDY ON POSTHEAT TREATMENT OF OVERLAID AUSTENITIC METALS. Inagaki, Michio (National Research Inst. for Metals, Tokyo); Ei, Kazuo; Nakamura, Harumasa. Yosetsu Gakkaishi; 40: No. 6, 563-72(Jun 1971). (In Japanese).

Overlaid weld metals of austenitic stainless steel in a power reactor pressure vessel are usually postheated for a long period of time after welding. The heat treatment is considered a kind of sensitizing, and it is important to check the soundness of the weld metal after heat treatment, especially about the precipitation of carbides. Studies were made on the distribution of delta ferrite and its change by reheating, precipitation of carbides and their identifications, and the sigma phase. Precipitation of delta ferrite from molten weld metal was found to depend on solidification phenomenon. There was a small amount of ferrite near the bond or toe in which the local solidification time was short, compared with other parts of the weld metal. Ferrite was not found at any specific location due to macrosegregation or extremely rapid solidification. The shape and amount of ferrite were changed by reheating after solidification. Ferrite growth was increased by heating at 1350°C for 15 sec. It was spheroidized by heating at 1200°C. There were five types of carbides developed after postheating: dot-shaped carbide; massive carbide; precipitated carbide mostly due to diffusion of carbon from base metal; lamellar carbide by eutectic reaction; and precipitated carbide due to tempering of martensite. The first two types of carbides were $M_{23}C_6$ type except for a relatively intense postheating of 700°C. A M_6C carbide was detected with $M_{23}C_6$ carbide after postheating at 700°C. It should be noted that dot-shaped carbides were linked to each other on an austenite grain boundary when there was no ferrite, and massive carbides co-existed sometimes with sigma phase. The lamellar carbide, which had not been pointed out in previous study, precipitated on an austenite grain boundary near the base metal after a fairly large degree of carbon diffusion from the base metal. The eutectic phase was very soft and it would be undesirable in a side bend test which is required as part of the test procedure for power reactors. (auth) (Japan)

544 CHANGES IN THE STRUCTURE OF MOLYBDENUM AT HIGH TEMPERATURES. Lozinskii, M. G.; Teplitskii, M. D. (Inst. of Mechanical Science, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); No. 7-8, 583-5(Jul-Aug 1970).

Translated from Metalloved. Term. Obrab. Metal.; No. 7, 35-6 (Jul 1970).

High-temperature metallography was used to study the fine crystal structure of commercially pure Mo containing less than 0.1% impurities. The microstructure of Mo in the process of high-temperature heating, holding, and loading was examined (at a magnification of 100) in the apparatus and also in the MIM-8 microscope. The structure of the Mo after the tests was revealed by electrolytic polishing. Transition from intragranular to intergranular fracture occurred at 1400°C ($0.53T_m$) at elongation rates of 0.55 and 1.38 mm/hr. Such elongation rates resulted in plastic deformation of polycrystalline Mo, accompanied by intragranular slip. The distance between slip planes at a magnification of 2000 x was 1 to 3 μ. (P.C.H.)

545 STRUCTURE AND MECHANICAL PROPERTIES OF U ALLOYS WITH A LOW V CONTENT. Collot, C.; Reisse, R. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Mem. Sci. Rev. Met.; 68: No. 6, 419-34(Jun 1971). (In French).

The phase transformations of the U–V alloys (between 0 and 1 wt per cent V) slowly cooled or quenched were studied. When the C content of the alloy became higher than 150×10^{-6}, an amount of 0.3 per cent of V was required for obtaining a thin grain structure. Analysis of the precipitates showed the existence of a solid state interaction between V and C. The tensile properties of the alloy varied as a function of the U_α grain size. The results obtained were applied to the study of the electron beam welding of alloys. (France)

546 THERMAL ETCHING OF (100), (110), AND (113) ORIENTED FACES OF TUNGSTEN SINGLE CRYSTALS. Lea, Colin; Mee, C. H. B. (Univ. of Southampton, Eng.). Surface Sci.; 25: No. 2, 332-6(Apr 1971).

Single-crystal tungsten discs, cut to expose the (100), (110), and (113) faces, were outgassed by electron bombardment. Small regions of the crystal surfaces were found to show a structure consisting of two sets of parallel furrows which intersect at an angle characteristic of the crystal face. (auth)

547 FORMATION OF DOMAIN STRUCTURE IN 50:50 MAGNESIUM–CADMIUM ALLOY. II. Makogon, M. B.; Igonin, G. S.; Igonina, T. N. Fiz. Metal. Metalloved.; 30: No. 4, 727-32(Oct 1970). (In Russian).

The effect of heat treatment and cooling rate on the microstructure of MgCd was studied, with special reference to the formation of domain structure in samples cooled from temperatures above the order–disorder transformation point. The formation of a fine domain structure in samples cooled from such temperatures took place extremely rapidly. As the structure developed, a system of internal stresses, easily revealed by x-ray diffraction, spread over the whole alloy. On ageing the alloy, the domain structure became coarser and the stresses were partially relieved. (Metals Abstr.)

548 STRUCTURAL STUDY OF THE QUASI-BINARY $Zr_{0.35}Ti_{0.65}$–H(D) SYSTEM. Miron, N. F.; Shcherbak, V. I.; Bykov, V. N.; Levdik, V. A. Sov. Phys.-Cryst. (Engl. Transl.); 16: No. 2, 266-9(Sep-Oct 1971).

Translated from Kristallografiya; 16: No. 2, 324-8(Mar-Apr 1971).

The interaction between hydrogen and the intermetallic compound $Zr_{0.35}Ti_{0.65}$ is considered. As the hydrogen content increases, it is found that, in addition to the ordinary α, δ, and ϵ phases (isostructural with the corresponding phases in the binary systems), another new phase $Zr_{0.35}Ti_{0.65}H(D)_{1.33}$ with a cubic lattice and a different space group (Fd3m) is also formed. The positions of the atoms in the unit cell of the new phase are determined. (auth)

549 STRUCTURE OF METASTABLE PHASES IN THE NICKEL–NIOBIUM SYSTEM. Zakharova, M. I.; Khatanova, N. A. (Moscow State Univ.). Sov. Phys.-Cryst. (Engl. Transl.); 16: No. 2, 361-3(Sep-Oct 1971).

Translated from Kristallografiya; 16: No. 2, 437-8(Mar-Apr 1971).

An electron-diffraction study was made of the structure of the metastable phase which separates from the supersaturated solid solution in Ni–10 at. % Nb during aging at 800°C. Annealing for 1 to 10 hr at 800°C produced a solid-solution superlattice with the unit cell parameter of the matrix trebled along one axis, while annealing for 40 hr produces a superlattice with the unit cell parameters trebled along two axes. (D.L.C.)

550 PHASE DIAGRAM OF THE SYSTEM Au–In. Nikitina, V. K.; Babitsyna, A. A.; Lobanova, Yu. K. (Inst. of General and Inorganic Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 371-6(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 421-7(Mar 1971).

Results are presented on the reaction of gold with indium at concentrations of 0 to 100 at. % by differential-thermal and x-ray phase analysis and by determinations of the microstructure, hardness, and microhardness. Results confirmed the existence of the compounds $AuIn_2$ and AuIn, which melt congruently at 540 and 511°C, respectively, and Au_2In, which melts incongruently at 505°C. It has been established that the peritectic reaction at 460°C leads to formation of the compound Au_3In_2, which decomposes by a eutectoid reaction at 270°C into AuIn and the γ-phase. The compound Au_3In_2 has a hexagonal lattice with: a = 4.55 kX, c = 9.05 kX, and c/a = 1.99. A limited region of solid solutions, which does not exist below 270°C, is formed on the basis of Au_3In_2. The γ-phase, which has the structure of γ-brass, undergoes a polymorphic change at 370 to 380°C. The region of the solid solution of In in Au extends to the alloy with 9.9 at. % In. (auth)

551 PHASE DIAGRAM OF THE SYSTEM Er–Fe. Kolesnikov, V. E.; Trekhova, V. F.; Savitskii, E. M. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 433-4(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 495-7(Mar 1971).

Results of phase studies of Er–Fe alloys are presented. Microstructural methods were used along with thermal and x ray measurements. Hardness and electric conductivity measurements were also made. (J.R.D.)

552 DISCUSSION OF THE ISOTHERMAL DECOMPOSITION OF AUSTENITE IN Fe–Mo–C ALLOYS. Nehrenberg, A. E. (Wallace-Murray Corp., Lockport, N. Y.). Met. Trans.; 2: No. 8, 2283-4(Aug 1971).

It is noted that in the referenced article [Berry et al., Met. Trans., 1970, Vol. 1, pp 3279-86] on Fe–Mo–C alloys, the authors observed but did not recognize evidence of a high-temperature transformation reaction involving the decomposition of δ ferrite. When δ ferrite is encountered, a dimension is added to the metallography of high alloy steels which does not exist in C steel and low alloy steels. A need for additional research toward understanding this aspect of high alloy steel metallography is noted. (J.R.D.)

553 ISOTHERMAL DECOMPOSITION OF AUSTENITE IN Fe–Mo–C ALLOYS. Berry, F. G.; Honeycombe, R. W. K. (Cambridge Univ., Eng.). Met. Trans.; 1: No. 12, 3279-86 (Dec 1970).

High purity iron alloys containing molybdenum and carbon have been isothermally transformed in the range 600 to 900°C and the structures examined optically and in the electron microscope. The decomposition of the austenite commences at the grain boundaries forming two different ferrite/carbide morphologies. Predominantly, fine fibers of Mo_2C, 300 to 500 Å in dia, grow in association with ferrite and in contact with the austenite, forming characteristic nodules. Increasing the carbon content from 0.2 to 1.0 wt % results in a change in structure during transformation from Mo_2C fibers/ferrite to a typical coarse pearlite reaction. In addition, Mo_2C nucleates repeatedly at the moving $\gamma-\alpha$ phase boundary to form sheets of particles about 200 to 400 Å apart, the individual acicular particles being about 50 Å in dia during the early stages of precipitation. (auth)

554 CRYSTALLOGRAPHY OF DEFORMATION-TWINNING IN ALPHA-PLUTONIUM. Crocker, A. G. (Univ. of Surrey, Guildford, Eng.). J. Nucl. Mater.; 41: No. 2, 167-77(Nov 1971).

An analysis is given of the crystallography of deformation twinning in α-plutonium, which has sixteen atoms in its monoclinic unit cell. The 20 twinning modes with the smallest possible shears consistent with all or one-half of the lattice points shearing directly to correct twin positions are tabulated. However in a structure with this degree of complexity the atomic shuffles accompanying any twinning shear must, of necessity, be very involved. In order to analyze these shuffles a pseudo-structure with only two atoms in its monoclinic unit cell is introduced. The twinning modes in this structure which correspond to the 20 modes obtained previously for the true structure are then examined and it is deduced that only two modes are acceptable. These have twinning elements $K_1K_2\eta_1\eta_2$; g given by (001) $(\bar{2}01)$ $[\bar{1}00]$ [102]; 0.159, $(\bar{2}01)$ (001) [102] $[\bar{1}00]$; 0.159. These modes were also predicted in an earlier analysis by Sebilleau. The detailed atomic shuffles associated with these modes are examined in both the pseudo-structure and in the true structure and it is concluded that both modes are likely to operate in practice. However, consideration of the production of twinning dislocations in the two interfaces suggests that $(\bar{2}01)$ twins are favored. The predictions are consistent with the very limited amount of experimental information which is available. (auth)

555 ALLOYS OF HAFNIUM WITH TRANSITION METALS. Shurin, A. K.; Dmitrieva, G. P. (Inst. of Metal Physics, Kiev). Metallofizika; No. 29, 16-23(1970). (In Russian).

Existing data relating to the formation of alloys between Hf and various transition metals (Sc, Zr, Ti, Re, U, etc.) are collected and generalized in the form of phase diagrams. The principal chemical and physical properties of Hf itself are tabulated and compared with those of other similar metals. Some new data relating to the formation of intermetallic compounds in the Hf–transition-metal systems are presented and correlated with existing phase diagrams and other isolated data. (Metals Abstr.)

556 LAWS GOVERNING THE FORMATION OF VARIOUS TYPES OF PRIMARY CRYSTAL GROWTH [IN ALLOYS]. Finagina, E. V. (Dnepropetrovsk State Univ., USSR). Metallofizika; No. 29, 180-4(1970). (In Russian).

The laws governing the formation of particular types of primary crystal growth in metals and alloys are discussed from a theoretical point of view and compared with experimental results obtained for alloys of the eutectic Bi–Sn and Bi–Cd systems. Thus, depending on the precise composition of the alloy, there are particular temperature ranges corresponding to the formation of polyhedral and dendritic crystals. Primary Sn crystals in Bi–Sn alloys containing up to 30 at. % Bi, for example, always have a dendritic growth form. (Metals Abstr.)

557 CATHODIC VACUUM ETCHING OF URANIUM ALLOYS. Duran, J. B.; Fisher, R. E. (Sandia Labs., Albuquerque, N. Mex.). Microstructures; 2: No. 6, 23-4(Oct-Nov 1971).

A metallographic technique for cathodic vacuum etching isothermally treated uranium alloys is described. Details of the procedure and a comparison between cathodic vacuum and electrolytic etching are given. (auth)

558 AXIAL RATIO CHANGES IN TERNARY F.C.T. PHASE ALLOYS OF THE In–Ga–Tl SYSTEM. Matsuo, Y. (Nara Womens Univ., Japan); Kogachi, M. Acta Met.; 19: No. 11, 1287-91(Nov 1971).

The lattice parameters and the axial ratio of disordered f.e.t. In-rich alloys in the ternary system of In–Ga–Tl are measured by the x-ray powder method. The results show that the axial ratio remains constant with increasing Ga content along lines of constant Tl concentration, while it decreases appreciably with increasing Tl content along lines of constant Ga concentration. These trends are qualitatively interpreted in terms of the relation of the first few reciprocal lattice vectors to the first zero position in the mean pseudopotential of the alloy (the "q_0-effect"). (auth)

559 FEATURES OBSERVED IN THE URANIUM ALLOY, MULBERRY, BY SCANNING ELECTRON MICROSCOPY. Miglionico, C. J.; Thomas, G. J. (Sandia Labs., Albuquerque, N. Mex.). Microstructures; 2: No. 6, 30-1(Oct-Nov 1971).

Studies were made to determine if banding in Mulberry alloy is stress- or deformation-related, if a second phase is being delineated, or simply if the banding is an artifact produced by over-etching. The results indicated that the observed banding within grains is likely to be a stress related phenomenon. It is emphasized, however, that the banding is strictly a surface manifestation and, in order to properly understand the mechanisms involved, crystallographic relations must be established. (P.C.H.)

560 OMEGA PHASE TRANSFORMATION IN TITANIUM ALLOYS AS AN EXAMPLE OF DISPLACEMENT CONTROLLED REACTIONS. De Fontaine, D.; Paton, N. E.; Williams, J. C. (North American Rockwell Corp., Thousand Oaks, Calif.). Acta Met.; 19: No. 11, 1153-62(Nov 1971).

The omega phase is shown experimentally to be formed by cooling certain certain metastable $\beta-$Ti alloys to cryogenic temperatures. The transformation is completely reversible and is characterized by a small temperature hysteresis. The diffusionless hexagonal ω phase so formed is of the same composition as the parent bcc β phase, and the gradual progression from diffuse streaking in the diffraction patterns of the β phase to the sharp ω reflections is interpreted in terms of a displacive-type reaction. Computer-generated plots of the elastic energy of harmonic displacement waves in the bcc lattice are shown to reproduce many of the features of the diffuse intensity in the electron diffraction patterns. The complex quasi-circular streaks observed in some zone patterns are shown to result from the planar intersection of spherical surfaces of intensity in reciprocal space. It is suggested that the progressive transition from circular to rectilinear streaks correspond to a decreased coupling between {111} displacement modes responsible for the diffuse intensity. At sufficiently low temperatures, the diffuse streaks, which lie close to traces of {111} planes, contain sharp intensity peaks at positions $\frac{1}{3}\langle 112\rangle$, characteristic of the ω phase. (auth)

561 REACTIONS IN THE SYSTEM EUROPIUM–BORON. Savitskii, E. M.; Arabei, B. G.; Bakarinova, V. I.; (and others). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 539-41(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 617-19(Apr 1971).

From the results of the investigation of alloys of europium with boron, a hypothetical phase diagram of the system is proposed. Europium forms only one compound with boron, EuB_6; its fusion leads to decomposition, accompanied by evaporation of europium. The compound EuB_6 and boron form a practically degenerate eutectic with a melting point of 2080°C; the solubility of europium in boron is ~0.23 wt %. Alloys of europium with boron, containing more than 70 wt % Eu, cannot be obtained by fusion. (auth)

562 SYSTEM Ce–Ni–B. Kuz'ma, Yu. B.; Bilonizhko, N. S. (L'vov State Univ., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 542-4(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 620-3(Apr 1971).

X-ray structural analysis methods were used to investigate the system Ce–Ni–B. The existence of six ternary compounds was established, and data on the crystalline structure of five of these were obtained. (auth)

563 Pu–Ti SYSTEM. PHASE DIAGRAM AND DIFFUSION OF Pu IN Tiβ. Languille, A. (CEN, Fontenay-aux-Roses, France). Mem. Sci. Rev. Met.; 68: No. 6, 435-41(Jun 1971). (In French).

The Pu–Ti phase diagram shows a solid bcc TiPuβ solution (between 0 and 50 wt % Pu at 900°C). The diffusion of Pu in this phase was studied on bulk couples (alloys containing between 0.3 and 3 wt % Pu). The results obtained by x-ray microanalysis and autoradiography give a value of about 20 kcal for the activation energy between 900 and 1200°C. Consequently, Tiβ was confirmed to be an abnormal bcc metal when considering diffusion phenomena. The diffusion coefficient is almost independent of the concentration. (France)

564 MIXED CRYSTAL SERIES IN T^5–Al SYSTEMS. Girgis, K. (Eidgenoessische Technische Hochschule, Zurich). Z. Kristallogr.; 133: 66-74(1971). (In German).

A wide range of solid solubility has been observed in the following systems V_3Al (W type)–Nb_3Al (Cr_3Si type), V_3Al (W type)–Ta_3Al (sigma type) and Nb_3Al (Cr_3Si type)–Ta_3Al (sigma type). It has also been observed that annealing the samples at a higher temperature (1400°C compared with 1100 or 1200°C) favors the formation of the phases of higher symmetries, e.g., W type rather than Cr_3Si or sigma type; Cr_3Si type rather than sigma type. In spite of the fact that the sigma phase does not exist in the binary system V–Al, it occurs in the ternary system V–Ta–Al in the composition range from Ta_3Al to $V_{1.0}Ta_{2.0}Al$. (auth)

Radiation Effects

Refer also to abstracts 229, 245, 246, 252, 261, 291, 650, 1199, 1549, 1608, and 1673.

565 (AI-AEC-12818, pp 35-40) RADIATION DAMAGE IN CRYSTALLINE SOLIDS. Bauer, W.; Keefer, D. W.; Neely, H. H.; Sosin, A.; Thommen, K. H.; Vawter, D. D. (Atomics International, Canoga Park, Calif.). Jan–Mar 1969.

In AEC unclassified programs.

Developments in research on the production of defects in crystalline solids by radiation and attainment of an understanding of their structure, interactions with each other, and with impurities and dislocations, their effects on the physical properties of solids, and their recovery kinetics are reported. Studies on continuous Stage I annealing spectrum of Cu after 1.6-MeV electron irradiation; low-temperature electron and α particle irradiation of Ti; modulus changes at low temperatures, dislocation pinning in Cu; and semiconductor irradiations are discussed. (P.C.H.)

566 (AI-AEC-12860, pp 51-68) RADIATION DAMAGE IN CRYSTALLINE SOLIDS. Bauer, W.; Keefer, D. W.; Neely, H. H.; Thommen, K. H.; Vawter, D. D.; Sosin, A. (Atomics International, Canoga Park, Calif.). 1969.

In AEC unclassified programs.

Research developments in studies on the production of defects in crystalline solids by radiation to attain an understanding of their structure and their interactions with each other and with impurities and dislocations are reported. Continuous Stage I annealing spectrum of electron-irradiated Cu was studied along with low-temperature electron and α-particle irradiation of Ti, semiconductor irradiations, and dislocation pinning in irradiated Cu and Ag. (P.C.H.)

567 (AI-AEC-12887, pp 33-6) RADIATION DAMAGE IN CRYSTALLINE SOLIDS. Bauer, W.; Keefer, D. W.; Neely, H. H.; Thommen, K. H.; Vawter, D. D.; Sosin, A. (Atomics International, Canoga Park, Calif.). Jul–Sep 1969.

In AEC unclassified programs.

Research developments in studies on the production of defects in crystalline solids by radiation to attain an understanding of their structure, and their interactions with each other and with impurities and dislocations are reported. The topics discussed include proton irradiation of Ni at high temperatures and semiconductor irradiations. (P.C.H.)

568 (CEA-CONF-1842) DIMENSIONAL MEASUREMENTS UNDER IRRADIATION. Cartier, L.; Masson, M. [1971]. 11p. (In French). (PI(NT)-461-128; CONF-710628-1). Dep. NTIS (U. S. Sales Only).

From Euratom conference on radiation devices; Cadarache, France (10 Jun 1971).

Two methods for measuring dimensional variations of samples under irradiation are described. Diameter measurement can be used for clads submitted to internal pressure or for clad fuels. Length measurements by direct comparison also give excellent results under irradiation. (France)

569 (CONF-710301-(Vol.2), pp 485-93) NEUTRON CROSS-SECTION DATA APPLIED TO THE MATERIALS IRRADIATION STUDIES AT ORNL. Kerr, H. T.; Bell, M. J.; Bloom, E. E. (Oak Ridge National Lab., Tenn.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Irradiation damage studies of stainless steels require a knowledge of concentration histories and relative transmutation rates for the numerous elements present in the steels. A compilation was made of approximately 800 potentially relevant neutron-induced reaction cross sections and a fine-group library was formed. Data included were from the available libraries (i.e., UKAEA, GAM and ENDF/B), some semiempirical and theoretical models, and experiments. Using calculated energy spectra from the reactor systems of interest, the fine-group cross sections were weighted to produce spectrum-dependent reaction rate coefficients. These were then input into the ORIGEN code to produce the desired concentration histories and relative transmutation rates. Comparisons of these calculated results with available experimental results indicate fair agreement but point out the need for more detailed cross section data of this type, particularly for the (n,p) and (n,α) reactions. (auth)

570 (CONF-710916-2) ELECTRON DISPLACEMENT DAMAGE IN GRAPHITE AND ALUMINUM. Ohr, S. M.; Wolfenden, A.; Noggle, T. S. (Oak Ridge National Lab., Tenn.). [1971]. 9p. Dep. NTIS.

From fifth international materials symposium; Berkeley, Calif. (13 Sep 1971).

The study of in situ damage in graphite was concentrated on the contrast behavior of the defect clusters and on the threshold energy for displacing carbon atoms from the graphite lattice. Irradiations were carried out in a hot stage at temperatures of 300 to 600°C. The first appearance of damage occurred in approximately one minute for the conditions studied, and it was estimated from displacement cross sections that for the 30-min irradiation, approximately 4% of the carbon atoms were displaced. This is roughly equivalent to the number of displacements that would result from a fast-neutron irradiation of 3×10^{19} n/cm^2. However, no spots were observed smaller than about 40 Å in size. It was estimated that the threshold energy for displacement of carbon atoms from the graphite lattice is approximately 24 eV. Irradiation of zone-refined Al with 200 kV electrons at a current density of ~0.5 amp/cm^2 for 20 min led to damage consisting of small dislocation loops with a density of approximately 10^{15} loops/cm^3. The loops ranged in apparent size from 200 Å down to less than 20 Å with an average size of approximately 100 Å. Irradiation of 99 wt % Al with 200 kV electrons for periods up to one hour failed to generate visible damage. It was also noted that a 2024 Al alloy (4.5 wt % Cu, 1.5 wt % Mg, 0.6 wt % Mn) in the annealed or quenched conditions and after a fast-neutron irradiation of 4×10^{20} n/cm^2 failed to develop observable damage by electron irradiation. (P.C.H.)

571 (CONF-710916-3) ROLE OF ELECTRON MICROSCOPY IN THE UNDERSTANDING OF NEUTRON IRRADIATION-PRODUCED SWELLING. Wolfenden, A.; Farrell, K.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). [1971]. 11p. Dep. NTIS.

From fifth international materials symposium; Berkeley, Calif. (13 Sep 1971).

The significant role played by transmission electron microscopy in the studies of radioinduced swelling in nuclear reactor structural materials is reviewed. Void formation in the swelling process is discussed, along with the effects of irradiation temperature, neutron fluence, and pre-existing microstructure on the degree of swelling. Finally, some interesting features of void ordering and annealing are mentioned. (auth)

572 (CONF-710917-1) VOID DAMAGE IN NEUTRON IRRADIATED STRUCTURAL METALS. Bloom, E. E.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). [1971]. 21p. Dep. NTIS.

From Seminar on radiation effects in metals and structural materials; Kyoto, Japan (28 Sep 1971).

The tensile and creep-rupture properties of Types 304 and 304 + 0.15% Ti stainless steels were determined after irradiation at temperatures in the range 370 to 800°C to maximum fast neutron fluences of 3×10^{22} neutrons/cm^2 (>0.1 MeV). Changes in mechanical properties were related to the radioinduced defects. When irradiated in the annealed condition in the neighborhood of 400°C, Type 304 stainless steel exhibited an increased yield stress, reduced strain hardening coefficient, and reduced uniform and total elongation. The increased yield stress could be correlated with the strengthening expected from irradiation

produced voids and dislocations. With increasing irradiation temperature the concentration of these defects decreased and thus the magnitude of the yield stress increase became less. At 500 to about 600°C a pronounced reduction in creep-rupture ductility was observed. Fractures were intergranular. It is suggested that in this temperature range the void-dislocation structure together with the transmutation produced helium were responsible for the intergranular fractures and low ductilities. At higher temperatures no void-dislocation structures were formed. For these conditions the ductilities were higher than in the 500 to 600°C range but still significantly below the unirradiated value. Variation in alloy composition and preirradiation microstructure had a strong influence on the postirradiation properties. Type 304 + 0.15% Ti exhibited significantly higher tensile and creep-rupture ductilities than the standard alloy when irradiated and tested at 450°C and above. (auth)

573 (N-71-32242) ENERGY DEPENDENCE OF ELECTRON-INDUCED RADIATION DAMAGE IN TUNGSTEN. DiCarlo, James A.; Stanley, James T. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug 1971. 27p. (NASA-TN-D-6464). NTIS.

The onset and low-dose effective threshold energies for the 350°K production of electron-induced damage in tungsten were determined to be 50 ± 2 eV and 52 ± 2 eV, respectively (electron energy = 1.62 MeV). These results, when combined with bcc damage theory and other experimental data, suggest that (1) the 350°K thresholds should hold from 100 to 600°K, (2) the minimum recoil energy required for free interstitial production near 0°K is 53 ± 5 eV, (3) threshold in tungsten has little dependence on crystal direction, and (4) threshold in any bcc transition metal can be estimated by assuming a direct proportionality with Young's modulus. (auth) (STAR)

574 (ORNL-TM-3492) NUCLEATION AND GROWTH OF VOIDS IN STAINLESS STEELS DURING FAST NEUTRON IRRADIATION. Bloom, E. E. (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 46p. (CONF-710601-15). Dep. NTIS.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

The nucleation and growth of voids and dislocation loops in austenitic stainless steels were investigated by transmission electron microscopy and immersion density measurements. Annealed Type 304 stainless steel was irradiated at 370 to 800°C to fast neutron fluences up to about 1×10^{23} neutrons/cm^2 (>0.1 MeV). The effects of temperature, neutron flux, and neutron fluence on the concentration and spatial and size distribution of dislocations and voids are reviewed. Available results on the effects of composition and preirradiation microstructure are compared and related to data on annealed Type 304 stainless steel. The experimental observations are compared to the predictions of various void nucleation mechanisms. The results do not appear to be in agreement with the predictions of homogeneous nucleation theory as presently formulated. Nucleation mechanisms involving the presence of gases such as helium are capable of explaining many of the observations and trends but have not been described analytically. Void growth appears to be controlled by vacancy diffusion. (auth)

575 (SRARI-P-79) EFFECTS OF IRRADIATION ON THE MECHANICAL PROPERTIES OF f.c.c. ALLOYS OF THE Fe–Cr–Ni SYSTEM. PART 2. Balashov, V. D.; Votinov, S. N.; Prokhorov, V. I. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1970. 26p. (In Russian). INIS.

Results of mechanical testing of alloys are presented for the system Fe–Cr–Ni (X20H15, X20H40, X20H60, X20H80, and nickel) when irradiated at 70°C in water with a dose of 7×10^{21} fast neutrons/cm^2. For these materials the effects of high-temperature radiation embrittlement were characteristic, and intensified in the series from low-nickel alloys to pure nickel. Some theories are offered for the mechanism of the deformation of irradiated and unirradiated alloys. (tr-auth)

576 (SRARI-P-82) POSTIRRADIATION CHANGE IN SINGLE- AND POLYCRYSTAL NICKEL MECHANICAL PROPERTIES. Butra, F. P.; Votinov, S. N.; Golovshenko, Yu. M.; Korobeinikov, I. A.; Prokhorov, V. I.; Fufaeva, O. L.; Shamardin, V. K.; Krasina, T. A. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1970. 26p. (In Russian). INIS.

The relative elongation of irradiated monocrystals of nickel at 600 to 650°C did not undergo significant changes in the absence of polycrystalline nickel. In the case of the latter the ductility was practically zero at 600°C. It is possible that a lowering of the high-temperature ductility of polycrystalline nickel caused adverse intergranular damage and correlation between shear of grain body and boundary. (tr-auth)

577 (SRARI-P-84) NEUTRON IRRADIATION EFFECTS ON IRON AND CHROME STEEL. Balashov, V. D.; Votinov, S. N.; Prokhorov, V. I.; Shamardin, V. K. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1970. 23p. (In Russian). INIS.

Experimental results are presented for the effects of neutron radiation on the mechanical properties of iron and chrome steel under tensile stress and over the temperature region 20 to 800°C. The effect of high-temperature radiation-induced embrittlement, which is known for chrome nickel steels, is characteristic also for chrome steels but to a significantly smaller degree. (tr-auth)

578 (SRARI-P-88) STRUCTURAL CHANGE ACCELERATION IN ALUMINUM ALLOY UNDER REACTOR IRRADIATION. Votinov, S. N.; Sharov, B. V.; Yarkovoi, S. V.; Shamardin, V. K.; Sernyaev, G. A.; Raetskii, V. M.; Pokrovskii, A. S. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1970. 15p. (In Russian). INIS.

When Al–Mg–Si was subjected to chilling and aging, nuclear reactor radiation produces certain changes in its mechanical peroperties. It was also possible to obtain these changes outside the reactor with an increase in time of isothermal treatment during artificial aging. The magnitude of the effect depended upon the irradiation temperature and corresponded to structural changes. A change in the physical properties of the alloy (electric resistance and heat conductivity) following irradiation may be explained in terms of structural conversions and relaxation of stress. (tr-auth)

579 MECHANISM FOR VOID GROWTH IN IRRADIATED STAINLESS STEELS. Lungu, S. (Inst. for Atomic Physics, Bucharest). J. Nucl. Mater.; 41: No. 1, 115-18(Oct 1971).

A theoretical description is given of void growth based on changes induced by the strain field around a void on the mobilities of vacancies and interstitials. (P.C.H.)

580 ULTRASONIC ATTENUATION STUDY OF THE INTERACTION OF IRRADIATION PRODUCED PINNING POINTS WITH DISLOCATIONS IN COPPER. Ostermann, A.; Lenz, D.; Luecke, K. (Technische Hochschule, Aachen). J. Phys. (Paris), Colloq.; No. 2, 149-50(1971). (In French).

The stress-induced breakaway of dislocations from their pinning points was studied in Cu single crystals by measuring the ultrasonic attenuation α as a function of the externally applied stress τ. The pinning points were produced by γ irradiation at 295°K and subsequent step-wise annealing up to 400°K. An analysis of the $(\alpha)\tau$ dependence using dislocation resonance damping and breakaway theories enabled the energy binding the pinning points to the dislocations to be determined. The binding energy increased linearly when the density of the radioinduced pinning points increased. It decreased linearly during sample annealing between 500 and 650°K when the density of the pinning points decreased. (France)

581 SOLUTION OF IRON AND STEEL IRRADIATED WITH NEUTRONS. Laptev, N. Ya.; Spitsyn, V. I.; Balezin, S. A. (Inst. of Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 6: No. 1, 18-20(Jan-Feb 1970).

Translated from Zashch. Metal.; 6: No. 1, 23-6(Jan-Feb 1970).

A study was made of the action of neutron radiation on the kinetics of solution of Armco iron and steel-45 in acid solutions. The effect of defects caused by neutron bombardment in the metal and the action of internal β-radiation on the solution of radioactive specimens in sulfuric and hydrochloric acids is demonstrated. (auth)

Ceramics and Cermets

Refer also to abstracts 414–417, 419, and 420.

Corrosion and Erosion

Refer also to abstracts 427, 429, and 430.

582 HIGH-TEMPERATURE SOLAR TEST INSTALLATIONS OF THE INSTITUTE OF MATERIALS SCIENCE, ACADEMY OF SCIENCES OF THE UKRAINIAN SSR, FOR STUDYING THE SERVICE PERFORMANCE OF OXIDATION-RESISTANT COATINGS. Frantsevich, I. N.; Dvernyakov, V. S.; Pasichnyi, V. V. (Inst. of Materials Science, Kiev). pp 27-34 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Development and uses of solar furnaces in materials testing are described. One such furnace installation is used in studies of refractory materials and oxidation-resistant coatings in controlled media. Another installation is designed for use in studies of

thermal fatigue in coating materials in air. A third installation described is designed for testing coatings in high-temperature gas streams. (J.R.D.)

583 HIGH-TEMPERATURE REFRACTORY-COMPOUND COATINGS ON GRAPHITE. Burykina, A. L.; Evtushok, T. M. (Inst. of Materials Science, Kiev). pp 139-45 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Results are presented from work concerned with the development of a technique for the deposition of titanium and zirconium carbides, titanium and zirconium borides, and aluminum nitride on graphite and investigation of the effects of various process parameters. Particular stress was laid on ensuring that the resultant coatings had maximum density and firmly adhered to the base. The technique employed for depositing carbides on graphite comprises two consecutive stages: application of a metallic layer from a liquid phase in a vacuum and diffusion annealing, i.e., carbidization of the metallic layer. Techniques were developed for the coating of graphite with titanium and zirconium carbides and borides and aluminum nitride, consisting in the metallization of graphite and subsequent diffusion treatment (carbiding, boriding, or nitriding). (J.R.D.)

Preparation and Fabrication

Refer also to abstracts 432 and 468.

584 (DOCKET-701257-1) URANIUM OXIDE FUEL PLANT. Supplemental Environmental Report. (Jersey Nuclear Co., Richland, Wash.). 14 Oct 1971. 65p. (JN-14(Add.1)). Dep. NTIS.

Information is presented in support of the request for licensing to process and use special nuclear material for operation of the uranium oxide fuel fabrication plant at Richland, Washington. Air quality measurements, water quality measurements, environmental information, and modifications after 6 months of operation are discussed. Postulated accidents are discussed. An attempt was made to establish the overall cost-benefit relationship of the chosen location and process. (M.C.G.)

585 REACTION OF SILICON IN GLASSY CARBON. Suzuki, Hiroshige (Tokyo Inst. of Tech.); Kimura, Shiushichi; Sasaki, Tadao; Hase, Teizo. Nippon Genshiryoku Gakkaishi; 13: No. 8, 440-6(Aug 1971). (In Japanese).

Silicon carbide is considered to be promising as coating material for nuclear fuel and as temperature monitors in reactors. The mechanism of formation of SiC was examined by measuring the amount of diffusion of Si in carbon material. The reaction behavior of Si and glassy carbon at high temperatures was observed, mainly by means of electron probe microanalyzer. It was found that Si diffuses macroscopically in glassy carbon without the formation of any compound, in the temperature range of 1,500 ~ 1,800°C. The diffusion phenomenon can be explained approximately as one way volume diffusion of Si into the glassy carbon. The diffusion coefficient in the temperature range of 1,500 ~ 1,800°C can be expressed by $D = 2.1 \times 10^5 \exp(-125 \times 10^3/RT)$; R is the gas constant. These observations on the diffusion phenomenon support the assumption that Si can macroscopically form a solid solution with glassy carbon, and the solid solubility of Si in the glassy carbon is about 0.07 ~ 0.20 wt % in the temperature range of 1,500 ~ 1,800°C. (auth)

586 SYNTHESIS OF B_6O AT HIGH PRESSURES. Zubova, E. V.; Burdina, K. P. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 197: No. 5, 1055-6(11 Apr 1971). (In Russian).

The boron oxide B_6O was obtained by pressing a homogeneous mixture of B_2O_3 and amorphous boron at about 110 kilobars and high shear stress, according to the equation: $16\ B + B_2O_3 \rightarrow 3\ B_6O$. Evidence for this reaction was obtained from x-ray analysis and from a study of the shear stress of the pressed tablets as a function of pressure. The calculated density of 2.59 g/cm³ is comparable to the experimental value of 2.57 g/cm³. (K.S.W.)

587 METHOD FOR THE TREATMENT OF POWDERED URANIUM OXYFLUORIDE. Delpech, Andre (to Commissariat a l'Energie Atomique). French Patent 2,045,692. 5 Mar 1971. Filed 20 Jun 1969. (In French).

In this process, the specific surface of uranium oxyfluoride (BET method) produced by the hydrolysis of UF_6 in a fluidized bed is increased in order to improve the physical characteristics of the UO_2 obtained in the oxyfluoride pyrohydrolysis and for the fabrication of nuclear ceramic fuels. The method consists of reacting the powdered oxyfluoride with water vapor between 40 and 150°C, 50 to 90°C being the most preferable in order to hydrate the oxyfluoride. (France)

588 PROCESS FOR MANUFACTURING SINTERED CERAMIC OXIDE PELLETS. Bataller, Simone; Nezeraud, Philippe (to Commissariat a l'Energie Atomique). French Patent 2,041,615. 18 Jan 1971. Filed 2 May 1969. (In French).

A process for manufacturing sintered ceramic oxide pellets, in particular actinide oxide pellets, for use in fuel elements, is described. The pulverulent oxide is pressed into compact pellets, then heated in a reducing atmosphere to a temperature less than the oxides melting point over a period of time sufficient to induce sintering: the powder is subjected to a heat degassing treatment in partial vacuum which is effected at a temperature less than that required to induce sintering. (France)

589 PROSPECTS FOR RESEARCH ON CERTAIN INORGANIC MATERIALS. Tananaev, I. V. Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 321-30(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 361-74(Mar 1971).

Preparation and properties of refractory heat-resistant inorganic materials are discussed. Information is included on oxide ceramics, glasses, glass ceramics, and heat-resistant coatings for materials and alloys. (J.R.D.)

590 TERNARY NITRIDES OF ZIRCONIUM, THORIUM, AND URANIUM. Palisaar, A.-P.; Juza, R. (Univ., Kiel). Z. Anorg. Allg. Chem.; 384: No. 1, 1-11(Jul 1971). (In German).

Li_2ZrN_2, Li_2ThN_2 and Li_2UN_2 were prepared from Li_3N and $ZrN_{1.22}$ and Th powder and $UN_{1.42}$, respectively, in flowing NH_3 at temperatures between 700 and 1000°C. They have a hexagonal symmetry. On the basis of x-ray powder diffractograms the N^{3-} ions are approximately hexagonal-close-packed, the Zr^{4+} and Th^{4+}, respectively, are situated in octahedral, the Li^+ in tetrahedral holes. $BeThN_2$ was prepared from Be_3N_2 and Th_3N_4 in a high-frequency furnace between 1400 and 1880°C. This compound crystallized with a hexagonal symmetry. (auth)

591 EQUIPMENT FOR THE FABRICATION OF CERAMIC CASTING MOLDS. Albouy, Georges; Boncoeur, Marcel; Sernissi, Jean (to Commissariat a l'Energie Atomique). French Patent 2,039,529. 4 Jan 1971. Filed 2 Apr 1969. (In French).

Equipment for the fabrication of ceramic molds for uranium casting is described which consists of a basic plate with a protuberance covered by an exterior device. The equipment possesses an envelope which covers the protuberance and/or the exterior device; it is of adjustable thickness and limits the free space left between the protuberance and the exterior device. (France)

592 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF NUCLEAR FUEL ELEMENTS. Price, Michael Stuart Thomas; Gough, John Richard Cox; Meaden, Geoffrey William (to United Kingdom Atomic Energy Authority). British Patent 1,249,156. 13 Oct 1971. Filed 22 Apr 1968.

Reference is made to the manufacture of coated particle fuel elements. Under some operational conditions coated particle fuel agglomerates manufactured according to proposed methods have proved somewhat unsatisfactory. For example, the bond between adjacent particles may easily fracture during manufacture or under the stresses and strains that occur due to dimensional changes in operational use. In the method of manufacture described an overcoating is applied to the particles using powdered graphite/resin mixture in the proportions 40 to 60% graphite, the mass of particles then being heated to form a strong agglomerate. The application of the overcoating is performed by tumbling the particles in a rotary drum, while alternately introducing the graphite resin mixture and then a spray of resin solvent. For the manufacture of annular shape fuel elements, the overcoated fuel particles are poured into a plastic film lined annular mold, and the mold then heated to cure and carbonize the resin. (UK)

593 COATING PROCESSES. Sturge, Derek William James; Meaden, Geoffrey William (to United Kingdom Atomic Energy Authority). British Patent 1,246,046. 15 Sep 1971. Filed 27 Mar 1969.

A process for the production of coated articles is described in which the articles are subjected to a grading operation. It comprises a number of similar coating stages; undersized articles detected by the grading operation are passed back for further treatment and oversized articles are restored to the uncoated condition and recycled. A particular application of the process is to the production of carbon-coated nuclear fuel particles or microspheres. The coating stages are carried out by tumbling the particles in a revolving drum into which the resin containing coating powder is fed, with a separate drum for each stage. Transfer of particles between the drums may be by fluidization tech-

niques. The coating is accomplished by tumbling in a resin solvent. (UK)

594 COATED PARTICLE FUELS. Rose, K. S. B. J. Inst. Nucl. Eng.; 12: No. 5, 142-3(Sep-Oct 1971).

Discussion following lecture on the subject given by the author at University College, London, on 20 May 1971 (loc. cit., 12: No. 4, 95(July/Aug 1971)). (UK)

595 LOW-EVAPORATION MELTING OF URANIUM/PLUTONIUM CARBIDE. Krauth, A.; Teiwes, H.-J. (Nukem GmbH, Hanau, Ger.). Kerntech. Atomprax.; 13: No. 7-8, 329-30(Jul-Aug 1971). (In German and English).

A method is described for melting uranium/plutonium carbide mixed crystals in a ceramic sleeve by direct passage of electric current. The ceramic sleeve limits the reaction space and also serves as insulator. The advantages of this method are: a short reaction time (1 to 2 sec); an enclosed system reducing possible plutonium losses; and melting of a large proportion of the charge making it possible to suppress enrichment of Pu in the unmelted material. (auth)

Properties Evaluations

Refer also to abstracts 266, 278, 498, 502, 751, 948–950, 955, 959, and 974.

596 (BNWL-SA-3844) OXYGEN DISSOCIATION PRESSURES AND PHASE BEHAVIOR IN THE TRANSPLUTONIUM OXIDES. Chikalla, T. D.; Turcotte, R. P. (Battelle Pacific Northwest Labs., Richland, Wash.). 29 Sep 1971. Contract AT(45-1)-1830. 32p. (CONF-711019-2). Dep. NTIS.

From fifth materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971).

The results of recent oxygen vapor pressure measurements over nonstoichiometric AmO_x, CmO_x, and BkO_x are presented. These include derived information concerning the phase relations and partial thermodynamics of oxygen solution over the range $1.5 < x < 2.0$ and $300 < T < 1200°C$. The americium-oxygen system has been examined by thermogravimetric techniques in the single phase α region for $1.80 < x < 2.00$ to yield relative partial molar heat and entropy data. Supporting information obtained by quench methods and x-ray diffraction analysis extend the results to lower compositions and, additionally, demonstrate the existence of a bcc σ phase over a wide composition range. Phase relations in the curium-oxygen system have been defined by a series of isobars in the pressure range $2 < P_{O_2}$ (mm) < 730. In addition to α and σ phases, compounds of more narrow compositional width are seen at $CmO_{1.72}$ and $CmO_{1.82}$, and a plausible phase diagram is constructed. Differences obtained on two curium isotopes of greatly different radioactivity are discussed. The berkelium-oxygen system has been examined using a novel capacitance manometer system and a 1.2 mg sample. A set of five isotherms was obtained over the range $852 < T$ (°C) < 1150. The isotherms show a regular variation across α and σ regions separated by a diphasic field at $x \sim 1.79$. In addition, a narrow two-phase region exists between $BkO_{1.91}$ and $BkO_{1.93}$. Certain similarities are shown to exist between this and certain other fluorite related ternary oxide systems. In addition, melting behavior of the di- and sesquioxides and polymorphism in the sesquioxide is described over the entire actinide series. (auth)

597 (LA-4704) HIGH TEMPERATURE COMPRESSIVE CREEP AND HOT HARDNESS OF URANIUM–PLUTONIUM CARBIDES. Tokar, Michael (Los Alamos Scientific Lab., N. Mex.). Jul 1971. Contract W-7405-eng-36. 13p. Dep. NTIS.

The compressive creep of uranium–plutonium carbides having the composition $U_{0.79}Pu_{0.21}C_{1.02}$ and a sintered density of 11.8 g/cm^3 was studied at 1300, 1400, and 1500°C and stresses of 2000, 4000, and 6000 psi. The equation which best fitted the data was $\dot{\epsilon} = 7.96 \times 10^4 \sigma^{2.44} \exp(-126.4 \text{ kcal/mole/RT})$. The dominant creep mechanism was probably grain boundary sliding. The hardness of some monocarbides with various U/Pu ratios was measured from room temperature to 1200°C. Probable mechanisms of deformation are discussed. (auth)

598 (LA-4749) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Status Report, April 1–June 30, 1971 and Fifth Annual Report, FY 1971. Baker, R. D. (comp.) (Los Alamos Scientific Lab., N. Mex.). Aug 1971. 68p. Dep. NTIS.

Controlled-potential coulometry was applied to the determination of Pu and U in irradiated $(U,Pu)O_2$ fuels that had undergone as much as 6 at. % burnup. Variations in results of samples taken at 5 locations on a failed fuel pin apparently resulted from a large variation in Na content. It was found that a separation of Pu and U from radioactive fission products is necessary for an accurate determination when the burnup exceeds 6 at. %. Two proven methods for measuring O_2 were adapted and remotized for hot cell use. A method was developed in which Pu and U are sequentially separated on a single anion exchange column and individually analyzed for isotopic abundances by thermal ionization mass spectrometry. The effects of impurities on the measurement of O/M atom ratios by a thermogravimetric method were determined. Sulfur and phosphorus were determined in FFTF fuels by spectrophotometric methods. Chlorides, fluorides, carbon, water, and gases were also determined in mixed oxide fuels. A spectrophotometric method was used for the determination of trace amounts of U in ceramic grade PuO_2. A carrier distillation emission spectroscopic method was developed for the determination of metal impurities in PuO_2, UO_2, and mixed oxide fuels. Rare earths were determined in mixed oxide fuels by emission spectroscopy. Information is also included on Pu ceramic fuels research. (J.G.B.)

599 (SRARI-P-70) ON THE GAS RELEASE MECHANISM DURING THE ISOTHERMAL ANNEALING OF IRRADIATED DISPERSED FUEL COMPOSITIONS BASED ON UO_2. Davydov, E. F.; Zavidovskii, V. Ya.; Kolesov, V. V.; Syuzev, V. N.; Chushkin, Yu. V. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1970. 13p. (In Russian). INIS.

Gas release from samples of UO_2–Al–Cu during isothermal annealing was measured. The mechanism may involve self-diffusion and annealing of radiation defects in the crystalline lattice of the material matrix. A hypothesis is offered to explain an increase in the rate of gas evolution during an increase in fuel burn-up. (tr-auth)

600 PARAMETRIC STUDY OF BOROSILICATE GLASSES FOR RADIOACTIVE WASTE SOLIDIFICATION. Levi, H. W.; Lutze, W.; Malow, G. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Atomwirt., Atomtech.; 16: No. 7, 359-60(Jul 1971).

Variations in composition were designed to study some effects caused by replacing Al_2O_3 or B_2O_3 and $NaBO_2$ or $NaAlO_2$, respectively by SiO_2 in borosilicate glass. The results showed that keeping the B_2O_3 content at $x = 2$ the leach resistance seemed to level off when the Al_2O_3 content approached $y = 1$. Further improvement was achieved by reducing the B_2O_3 content to $x = 1$. Any additional reduction had little effect on Na solubility but caused a strong increase in B_2O_3 leachability. From the results, an approximate composition of the basic glass of $6SiO_2-2B_2O_3—Al_2O_3-2CaO-3Na_2O$ is suggested. (P.C.H.)

601 SOME LAWS GOVERNING THE FRACTURE OF COMPOSITE MATERIALS BETWEEN -196 AND +800°C. Novikov, N. V.; Voinitskii, A. G. Probl. Prochnosti; No. 8, 58-63(Aug 1970). (In Russian).

The results of an experimental investigation into the UTS and impact strength between −196 and +800°C of two-phase composite materials ($Cu-Al_2O_3$, Co–NbC, and $Fe-C-SiO_2$) with different types of internal structure are presented. The strength of composites of different structures depends markedly on the proportion of the second phase present. The manner in which the materials rupture depends on the relationship between the mechanical properties of the constitutents (e.g., high-strength fibers in ductile matrices form tough composites). (Metals Abstr.)

602 GONIOMETRIC STUDY ON THE CLEAVABILITY OF BORON NITRIDE. Alekseev, Yu. A. (All-Union Scientific-Research Inst. of Abrasives and Polishing, Moscow). Sov. Phys. Cryst. (Engl. Transl.); 16: No. 2, 382-3(Sep-Oct 1971).

Translated from Kristallografiya; 16: No. 2, 452-3(Mar-Apr 1971).

BN crystals were cleaved and the fragments examined in a goniometer. The results show that BN, which is used as an abrasive, can be cleaved along six differently oriented {110} planes. (D.L.C.)

603 THERMAL EXPANSION OF NONSTOICHIOMETRIC ZIRCONIUM CARBIDES. Bukatov, V. G.; Rymashevskii, G. A.; Fedorov, V. B. Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 457-8(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 519-20(Mar 1971).

The thermal expansion of nonstoichiometric ZrC was measured using a dilatometer. The specimens used were prepared by pressing and sintering at 2300°C forming a single phase. Results are presented in tables and graphs. (J.R.D.)

604 CERAMIC TREATMENT PROCESS. (to Kaman Sciences Corp.). British Patent 1,247,374. 22 Sep 1971. Priority date 28 Dec 1967, United States.

A method is described for production and treatment of a porous skeletal body used in hardened dimensionally stable products. An unsintered porous structure is prepared from particles comprising

at least one refractory metal oxide which is then impregnated with a metallic compound. The metallic compound is converted to oxide which hardens the structure. The converted oxide is cured and the impregnation-curing step is repeated. Tables of data are included in which properties of the starting materials and finished products are given. (J.R.D.)

605 DEFORMATION MECHANISMS IN SAP SINGLE CRYSTALS. Naj, A.; Schiller, P. (CCR–EURATOM, Ispra, Italy). J. Nucl. Mater.; 41: No. 2, 161-6(Nov 1971).

The deformation behavior of coarse-grained SAP and Puroxal single crystals has been determined. The stress-strain curves of both types of material can be divided into three parts which correspond to different hardening processes. A possible interpretation for the work-hardening could be in the range between $\epsilon = 0$ and $\epsilon = 10^{-3}$, the Fisher–Hart–Pry mechanism, between $\epsilon = 10^{-3}$ and 2×10^{-2} a generation of dislocation loops at the particles, and finally the normal work-hardening of the aluminum matrix. (auth)

606 SECONDARY CREEP BEHAVIOUR OF URANIUM MONOCARBIDE IN COMPRESSION. I. HYPOSTOICHIOMETRIC URANIUM MONOCARBIDE. Killey, N. M. (General Electric Co., Ltd., Wembley, Eng.). J. Nucl. Mater.; 41: No. 2, 178-86(Nov 1971).

The effect of temperature on the secondary creep rate of hypostoichiometric UC was examined over the range 900 to 1100°C at a stress of 6000 psi and the effect of stress over the range 4000 to 8000 psi at 950°C. From the creep behavior and metallographic observations it is concluded that the creep mechanism is controlled by the diffusion of constitutional carbon vacancies in the UC lattice. It is found that creep obeys equations of the form, $\dot{\epsilon} = A_1\sigma$ and $\dot{\epsilon} = A_2 \exp -\Delta H/RT$, where ΔH, the activation enthalpy for creep has a value of 45 ± 3 kcal per mole which is less than that for the diffusion of carbon in UC. A value calculated for the creep diffusion coefficient is however similar to that for the diffusion of carbon. (auth)

607 DISSOLUTION OF A BARRIER OXIDE FILM ON TUNGSTEN. Vas'ko, A. T.; Tobolich, V. V. Dopov. Akad. Nauk Ukr. RSR, Ser. B.; No. 8, 706-8(Sep 1971). (In Ukrainian).

A comparative dissolution rate determination of tungsten amorphous oxide films in a 0.1 N H_2SO_4 solution (at 1.5 to 125.5°) was carried out by interference, capacity, impulse, and residual current methods. The results of these four methods were in good agreement. The rate of dissolution was negligible, close to 0°C. It increased strongly with temperature. The activation energy of the oxide dissolution process was calculated using the Arrhenius equation. The transformation of the barrier oxide into the barrier porous one was interpreted in terms of metal hydroxide aging theory. (auth)

608 PARTICIPATION OF COMPONENTS OF THE SYSTEM Mo–Si IN REACTIVE DIFFUSION. Krivoruchko, V. M.; Sagalovich, V. V.; Patokin, A. P.; Podtykan, V. P. (Physical-Chemical Inst., Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 532-5(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 610-13(Apr 1971).

By several independent methods, it is proved that silicon preferentially diffuses in molybdenum disilicide, and also in the lower silicide phases Mo_5Si_3 and Mo_3Si. (auth)

609 DIFFUSION OF IRON IN STABILIZED ZIRCONIUM DIOXIDE. Timofeev, A. N.; Kotlyar, A. G.; Sadovnikov, Yu. B.; Neuimin, A. D.; Pal'guev, S. F. (Inst. of Electrochemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 557-60(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 638-42(Apr 1971).

Diffusion of Fe in ZrO_2–10 mole % Y_2O_3 was studied at annealing temperatures of 1370 to 1600°C, using ^{59}Fe tracer. The content distribution did not follow the volume diffusion law, indicating that diffusion via defects occurs. Due to porosity, diffusion was faster in coarser-grained specimens. (D.L.C.)

610 RELATION BETWEEN THE INITIAL VELOCITY OF REDUCTION OF THE V_2O_5–MoO_3 SYSTEM AND THE BINDING ENERGY OF OXYGEN WITH THE SURFACE. Golodets, G. I.; Il'chenko, N. I.; Pyatnitskii, Yu. I. (Inst. of Physical Chemistry, Kiev). Teor. Eksp. Khim.; 7: No. 3, 326-31(May-Jun 1971). (In Russian).

The rate of surface reduction by hydrogen of V_2O_5–MoO_3 mixtures with varying amounts of MoO_3 was measured. A relationship was found between the reduction rate and the equilibrium elasticity of desorption of oxygen from such surfaces. Reduction rate values may serve as a kinetic characteristic of the bond energy between oxygen and the oxide surface. (tr-auth)

611 HIGH TEMPERATURE X-RAY STUDY OF CARBON REACTIONS WITH REFRACTORY OXIDES. UO_2 PARAMETER IN THE PRESENCE OF C and CO FROM 1400 TO 2180 DEG C. THE PARAMETER IN EQUILIBRIUM WITH UC_2, AND CO AT 1769 DEG C. Pialoux, Andre; Dode, Maurice (Univ., Paris). Rev. Int. Hautes Temp. Refract.; 8: No. 2, 155-60(Apr 1971). (In French).

A carbon resistance furnace is described. It is adaptable to a Philips vertical goniometer and permits x-ray parameter measurements up to 2,400°C. It was used to study the effect of C on UO_2 at high temperature. (France)

612 METAL-IMPREGNATED CARBONS. Leeds, Donald H.; Kelly, Ed; Heicklen, Julian. Ind. Eng. Chem., Prod. Res. Develop.; 9: No. 4, 573-6(Dec 1970).

Metal compounds were incorporated into a rayon-based reinforced pyrolytic graphite and subsequently reduced to the metal or converted to the carbide to increase oxidation resistance. The impregnants used were $H_2ZrO(SO_4)_2 \cdot 3H_2O$, $TaCl_4$, $HfCl_4$, ZrH_2, B, and Si. None reduced flexural strength significantly. The first four impregnants increased resistance to burning, whereas the last five retarded weight loss in static oxidation tests at 1850°F. (Metals Abstr.)

Structure and Phase Studies

Refer also to abstracts 552 and 553.

613 (KFK-EXT-4/70-27) SEGREGATION OF URANIUM AND PLUTONIUM IN OXIDE NUCLEAR FUELS UNDER THE INFLUENCE OF A TEMPERATURE GRADIENT. Schumacher, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jul 1970. 65p. (In German). INIS.

An apparatus was constructed for investigations of segregation processes in mixed (U,Pu) oxide fuel materials subjected to a temperature gradient. The cylindrical specimens in sealed tungsten containers were exposed to temperatures up to 2800°K and longitudinal gradients up to 2000°K/cm. The measurement of the concentration by alpha counting showed a decrease of plutonium in the columnar grain region and an accumulation at the hot end of the specimens. This segregation is due to preferential evaporation at the surface of the specimens, preferential evaporation and condensation in migrating voids, and thermal diffusion. For the thermal diffusion, a heat transfer of 35 kcal/mol is estimated and longtime effects are calculated. The results of the study are the basis for a discussion of the segregation effects in reactor fuel elements. (INIS)

614 (LA-tr-71-72) THERMODYNAMICS OF INTERSTITIAL THREE-COMPONENT PHASES OF THE CARBOHYDRIDE TYPE. Andrievskii, R. A.; Kalinin, V. P.; Pepekin, G. I. Translated for Los Alamos Scientific Lab., Ill., from pp 457-66 of Thermodynamics of Nuclear Materials, 1967. Vienna, International Atomic Energy Agency, 1968. 13p. (CONF-670915-11). Dep. NTIS.

From Symposium on thermodynamics of nuclear materials with emphasis on solution systems; Vienna, Austria (4 Sep 1967).

This paper was abstracted from the original language and appeared in NSA as 22: 31507.

615 (UJV-2499-MCh) HIGH-TEMPERATURE TREATMENT OF SINTERED UO_2 PELLETS COMPACTED WITH BINDERS. Landspersky, H. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 28p. (In Czech). INIS.

UO_2 pellets compacted with 2% of polyvinyl alchohol or polyethylene glycol and sintered at 1500 to 1600°C were heat treated for ½ to 8 hours at temperatures between 1700 and 2200°C. At temperatures exceeding the sintering temperature neither polarization nor expansion was observed, the content of residual carbon after sintering being <50 ppM. Phase segregation was not found. Grain growth in these materials could be expressed by the equation $D^2 - D_0^2 = k.t^n$, where $n < 1$, but in most cases the values of n differed from the values observed in pellets compacted without binders. Similarly, the addition of binders resulted in a change in grain growth kinetics. Inhomogeneities in both grain size and pore size as well as in pore size distribution were observed that exceeded the inhomogeneities in pellets compacted without binders. A linear analysis applied in the quantitative estimate of porosity was found to be suitable for closed porosity, i.e., at high final pellet densities. The effect of micropores <1.3 μm could not be evaluated due to limitations resulting from the resolving power of the apparatus. (INIS)

616 APPLICATION OF ELECTRON MICROPROBE ANALYSIS TO THE STUDY OF PHASE TRANSFORMATIONS IN COATINGS. Levshuk, O. A.; Sagalovich, V. V.; Klevtsur, S. A. (Inst.

of Physical Chemistry, Moscow). pp 35-7 of Protective Coatings on Metals. Vol. 3. /Samsonov, G. V. (ed.). New York; Consultants Bureau (1971).

Reactions of NbC coating on graphite surfaces in the presence of molten Ti were investigated using electron microprobes. The analysis was based on the intensity of x ray emission related to elements being determined in the coating layers. A continuous record of intensity data provides a distribution curve of the element in the microsection. (J.R.D.)

617 PREPARATION OF SINGLE-CRYSTALLINE NbN AND Nb_4N_5 FILMS. Oya, Gin-ichiro; Onodera, Yutaka (Tohoku Univ., Sendai). Jap. J. Appl. Phys.; 10: No. 10, 1485-6(Oct 1971).

Single-crystal NbN films were epitaxially grown on MgO(100) plates by vapor-phase deposition from $NbCl_5$ and NH_3-H_2. Nb_4N_5 was formed by annealing the single-crystal NbN films for 2 hr at 950 to 1000°C in NH_3-H_2, with resulting superlattice spots in the electron diffraction pattern. The space group of Nb_4N_5 is I4/m (C_{4h}^5). (D.L.C.)

618 STUDY ON THE EQUILIBRIUM IN ZIRCONIUM–HYDROGEN SYSTEM. Tada, Masayoshi; Huang, Yen-C. (Tokai Univ., Tokyo). Tokai Daigaku Kiyo Kogakubu; 1970: No. 2, 37-41(Mar 1971). (In Japanese).

Measurements of hydrogen equilibrium pressure were made for a series of zirconium–hydrogen alloys in the composition range of 0.5 to 45 at. % hydrogen and at 400 to 900°C. The results obtained are discussed from the thermodynamic viewpoint. A partial equilibrium diagram was established for the zirconium–hydrogen system. Thermodynamic quantities obtained, such as heat of solution of hydrogen to both α and β phases, activities of zirconium in β phase alloys, and the free energy change due to hydrogen content. (auth) (Japan)

619 SPACE GROUP OF URANOCIRCITE HEXAHYDRATE. Moroz, I. Kh. Sov. Phys. Cryst. (Engl. Transl.); 16: No. 2, 246-9(Sep-Oct 1971).

Translated from Kristallografiya; 16: No. 2, 297-300(Mar-Apr 1971).

The symmetry of synthetic uranocircite hexahydrate was established by analysis of the profile of diffraction maxima recorded on a DRON-1 diffractometer. It was shown that this mineral belongs to the meta-autenite structure type, which in the present case has a monoclinic distortion with a monoclinic angle of 90°36′. The true unit cell is a primitive orthorhombic cell, with the parameters: a = 16.84 ± 0.01; b = 9.756 ± 0.007; c = 9.855 ± 0.004 Å, space group $P2_12_12$. (auth)

620 EUTECTOID DECOMPOSITION OF Ta_2C. Tardif, A.; Piquard, G.; Wach, J. (Centre National de la Recherche Scientifique, Villers-les-Nancy, France). Rev. Int. Hautes Temp. Refract.; 8: No. 2, 143-8(Apr 1971). (In French).

The eutectoid decomposition of Ta_2C at about 1400°C was studied. Three types of observations were made: x-ray identification of the phases formed, study of the variations of the electric resistance during heating in vacuum, and micrographic observations. (France)

621 SYSTEMS Ti–Co–B AND Ti–Re–B. Kuz'ma, Yu. B. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 452-4(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 514-16(Mar 1971).

Phase equilibria in the systems Ti–Co–B and Ti–Re–B were determined. Results are presented in tables and graphs. (J.R.D.)

622 VITRIFICATION IN THE SYSTEMS Tl–B–S AND Tl–B–Se. Dembovskii, S. A.; Kirilenko, V. V.; Buslaev, Yu. A. (Inst. of General and Inorganic Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 448-9(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 510-11(Mar 1971).

The boundaries of vitrification regions in the systems Tl–B–S, and Tl–B–Se were studied. Results are presented graphically and discussed. (J.R.D.)

623 SOLID-STATE REACTIONS IN THE SYSTEMS La_2O_3–NiO AND Pr_2O_3–NiO. Kniga, M. V.; Zaretskaya, R. A. (Belorussian State Univ., Minsk). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 408-10(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 464-7(Mar 1971).

The reaction kinetics and conditions of formation of compounds in the systems La_2O_3–NiO and Pr_2O_3–NiO in the temperature interval 600 to 1300°C were studied. Formation of $NiLa_2O_4$ and $NiPr_2O_4$ from 1:1 mixtures of the oxides begins to take place at an appreciable rate at 800 and 900°C, respectively. At 1300°C the reaction goes practically to completion. Reaction of the oxides (1:1, 1:3, 3:1, and 2:3) leads to formation only of $NiLa_2O_4$. The apparent activation energy for the initial stage of the reaction La_2O_3 + NiO is 28 kcal/mole. The compound $NiPr_2O_4$ has the same structure as $NiLa_2O_4$ and has a tetragonal lattice with a = 3.835 and c = 12.60 Å. (auth)

624 POLYMORPHIC TRANSFORMATIONS OF $Th(HCOO)_4$ AND $Ca(HCOO)_2$. Mentzen, Bernard (Institut National des Sciences Appliquees, Villeurbanne, France). Bull. Soc. Fr. Miner. Crist.; 94: No. 2, 138-40(Mar 1971). (In French).

The $\alpha \rightarrow \gamma$ transition of $Th(HCOO)_4$ is studied; it was possible to investigate for these two species the variations of the unit-cell axes with temperature, by means of a moving-film Debye-Scherrer camera recording the shifts of the diffraction lines with temperature in the range 25 to 250°C. It was also established that $Ca(HCOO)_2$ exhibits two new γ and delta polymorphic species. (France)

625 CRYSTAL STRUCTURE OF U_2IrC_2. Bowman, A. L. (Los Alamos Scientific Lab., N. Mex.); Arnold, G. P.; Krikorian, N. H.; Zachariasen, W. H. Acta Crystallogr., Sect. B; 27: Pt. 5, 1067-8(May 1971). (LA-DC-11791).

The crystal structure of U_2IrC_2 has been determined as tetragonal, space group I4/mmm, U in 4(e), z = 0.355 (1), Ir in 2(a), C in 4(e), z = 0.168 (1), by neutron diffraction. The lattice parameters are a_0 = 3.4804 (1), c_0 = 12.4821 (8) Å. (auth)

626 INVESTIGATION OF THE SYSTEM Zr–Fe–Si. Lisenko, L. A.; Ban, Z.; Gladisevskii, E. I. (Lvov State Univ. Inst. Rudjer Boskovic, Zagreb). Croat. Chem. Acta; 43: No. 2, 113-18(1971).

The isothermal section of the system Zr–Fe–Si was investigated using x-ray diffractometry and film techniques. The results were complemented with micrographic data. The existence of the compounds found previously: $Zr_4Fe_4Si_7$ (V), $ZrFe_2Si_2$ (D), ZrFeSi (E), and Zr_2Fe_3Si (λ,) was definitely confirmed. A new ternary phase of the composition $Zr_6Fe_{16}Si_7$ belonging to the $Mg_6Cu_{16}Si_7$ type was found (α = 11.53 ± 0.01 Å). Zirconium stabilizes the crystal structure of Fe_5Si_3 which as a pure phase exists only in the interval from 825 to 1090°C. The isoconcentration tie line at 66.7 at. % Zr indicates the existence of an unbroken series of solid solutions between Zr_2Fe and Zr_2Si. $ZrFe_2$ dissolves approximately 5 at. % of silicon. The solvolysis of the third component in all other binary phases was found to be very small. (auth)

627 PHASE TRANSFORMATIONS IN THE SYSTEM La_2O_3–SrO. Lopato, L. M.; Pavlikov, V. N.; Lugin, L. I.; Shevchenko, A. V. Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 8, 713-16(Sep 1971). (In Ukrainian).

The phase diagram of the binary system La_2O_3–SrO was plotted within the range of temperatures 1300 to 2350°C. The phase β with the homogeneity domain 30 to 35 mole % SrO at a temperature of 1960°C, the compound of $2La_2O_3-3SrO$ composition, and solid solutions on the base of initial oxides were identified in the system. The character of the changes in temperatures of polymorphous transformations A ⇌ H and H ⇌ X of lanthanum oxide in the presence of SrO additives was established. (auth)

628 PHASE EQUILIBRIUM IN THE SYSTEM $UO_2-UO_{2.67}-ThO_2$ AND $UO_{2+x}-NpO_2$. Paul, R.; Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Mater.; 41: No. 2, 133-42 (Nov 1971).

Solid-state chemical investigations have established that in the compositional range $UO_2-UO_{2.67}-ThO_3$ of the U–Th–O ternary system, the following single-phase domains exist: U_3O_8, which does not dissolve any ThO_3 in the solid state; an ordered M_4O_9 phase on the section between U_4O_9 and $U_2Th_2O_9$, below ≈1150°C; and a phase with fluorite structure which occupies a large part of the system and which at 1250°C is bounded by the compositions $UO_2-UO_{2.25}(U_{0.43},ThO_{0.57})O_{0.25}-ThO_3$. The maximum O/M ratio of the fluorite phase is O:(U + Th) = 2.25. The highest oxidation valency of uranium is 5.30; this value falls as more thorium oxide is incorporated in the $(U,Th)O_{2+x}$ fluorite phase. The quasi-binary $UO_{2+x}-NpO_2$ system ($p(O_2)$ = 1 atm) shows a marked resemblance to the corresponding $UO_{2+x}-ThO_3$ system; however, there is a slight measure of solubility of NpO_2 in U_3O_8 to give $(U.Np)_3O_{8-x}$. In the $(U.Np)O_{2+x}$ fluorite phase, neptunium is not oxidized to Np (>IV). (auth)

629 A REMARK ON THE PAPER "A CUBIC VARIETY OF URANIUM OXYSULFIDE." Popovic, S.; Tudja, M. (Ruder Boskovic Inst., Zagreb). J. Nucl. Mater.; 41: No. 2, 218-20 (1971).

In the referenced paper (see NSA 24: 14886), x-ray diffraction patterns of US and UO_2 showed weak peaks interpreted as reflec-

tions from phase X and identified as (111), (200), (220), and 311, indicating a fcc lattice. It is felt by the authors of this paper that the observed reflections are not from phase X but are reflections (111), (200), (220), and (311) from US and UO_2 corresponding to CuKβ radiation. (J.R.D.)

630 PHASE EQUILIBRIUM RELATIONSHIPS IN THE SYSTEM UN–UC–Fe. Guha, J. P. (Jozef-Stefan Inst., Ljubljana, Yugoslavia). J. Nucl. Mater.; 41: No. 2, 187-94(Nov 1971).

The phase equilibrium relationships in the system UN–UC–Fe were investigated by metallographic and x-ray diffraction methods. Certain features of the pseudo-binary join UN–Fe and UC–Fe were reexamined first and then the compatibility relationships between alloys of UN–UC and Fe were investigated. Various compositions of UN–UC solid solution were prepared by solid state diffusion and each of these fixed compositions of the solid solution was mixed with various proportions of Fe and fired in argon to higher temperatures to reach equilibrium. Several sections through the ternary diagram running from the Fe corner to selected compositions of U(N,C) edge were thus investigated. The results of the investigation show that the entire range of U(N,C) is compatible with Fe and that a binary eutectic valley occurs in the system. The position of the eutectic trough in the ternary diagram has been established and isotherms on the liquidus surface derived from several sections investigated are shown in a diagram. (auth)

631 CATHODIC VACUUM ETCHING OF MIXED OXIDE FAST REACTOR FUELS. Mastel, B.; New, K. H. (WADCO, Richland, Wash.). Contract AT(45-1)-2170. Microstructures; 2: No. 6, 13-15; 34(Oct-Nov 1971).

Methods developed to reveal the microstructure of nonirradiated and irradiated PuO_2–UO_2 fast reactor fuels are described. The results showed that the microstructure of nonirradiated and irradiated mixed oxide fuels can be developed by cathodic vacuum etching. The surface developed by cathodic etching was suitable for both optical examination and high-resolution electron microscope examination of replicas. Since no preferential attack occurs during cathodic vacuum etching, all phases are retained and therefore can be examined by microprobe analysis. (P.C.H.)

632 RARE EARTH OXIDE–ZIRCONIUM OXIDE SYSTEMS NEAR THE MELTING POINT. Rouanet, Alain (Centre National de la Recherche Scientifique, Montlouis, France). Rev. Int. Hautes Temp. Refract.; 8: No. 2, 161-80(Apr 1971). (In French).

Some characteristics of the ZrO_2–Ln_2O_3 systems near the melting point were determined by thermal and x-ray crystallographic analyses. The solidification and phase diagrams above 1800°C are given. Two new phases of cubic and hexagonal structures (X and H phases) were observed. The regions of homogeneity, unit-cell parameters, and various structure transformations were defined. The behavior of the materials in equilibrium near the melting point was compared to that of the same materials when quenched. (France)

633 PHASE EQUILIBRIA IN THE SYSTEM Al_2O_3–Nb_2O_5. Fedorov, N. F.; Andreev, I. F.; Kasparyan, R. M.; Smorodina, T. P. (Leningrad Tech. Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 561-3(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 643-7(Apr 1971).

The phase diagram of the system Al_2O_3–Nb_2O_5 was constructed. The system contains three individual compounds: $AlNbO_4$, $AlNb_{11}O_{29}$, and $AlNb_{49}O_{124}$. The first compound melts with decomposition at 1560°C, the other two without decomposition at 1450 and 1460°C, respectively. The peritectic has the composition 65 mole % Nb_2O_5 + 35 mole % Al_2O_3, and the eutectics correspond to the composition 73 mole % Nb_2O_5 + 27 mole % Al_2O_3 at 1425°C and 95 mole % Nb_2O_5 + 5 mole % Al_2O_3 at 1435°C. (auth)

634 DISTRIBUTION OF MAGNESIUM OXIDE IN COMPOSITIONS OF THE SYSTEM MgO–Al_2O_3–ZrO_2. Suvorov, S. A.; Klyucharov, Ya. V.; Kozlova, O. B. (Leningrad Tech. Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 573-6(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: N No. 4, 659-64(Apr 1971).

The distribution of magnesium oxide in compositions with a 1:1:1 ratio of MgO, Al_2O_3, and ZrO_2 depends on the chemical activity of the initial components and is accompanied by formation of both magnesium aluminum spinel and solid solutions of MgO in ZrO_2. The maximal amount of solid solution of magnesium dioxide in zirconium dioxide is formed in compositions involving magnesium oxide, roasted at 1750°C, electrofused corundum, and zirconium nitrate. Making use of the difference in the chemical activity of the components, we can make a selected change in the final phase composition of specimens of the system MgO–Al_2O_3–ZrO_2 with the same initial material composition. The shape of the thermal expansion curves of compositions of the system MgO–Al_2O_3–ZrO_2 is directly related to their phase composition. Compositions of this sytem, represented by two phases, namely spinel and monoclinic ZrO_2, display distinct hysteresis on the thermal expansion curve. If the roasted product contains in addition to these two phases a third phase, cubic zirconium dioxide, the thermal expansion curve of such a composition has a linear character. (auth)

635 CRYSTALLOGRAPHIC STUDY OF Ba_2FeUO_6 AND Ba_2CrUO_6. Grenet, J. C.; Poix, Paul; Michel, Andre (Paris Univ.). Ann. Chim. (Paris); 6: No. 1, 83-8(Jan 1971). (In French).

The crystallographic study of two compounds of the formula Ba_2MeUO_6 in which Me is either Fe or Cr established that they are perovskites with the following lattice constants a = 8.361 angstrom for Me = Fe and a = 8.301 angstrom for Me = Cr. Intensity measurements of the x-ray diffraction lines led to the allocation of the Fm3m space group to the Ba_2FeUO_6 compound which suggests complete ordering between Fe^{3+} and U^{5+} in the 4a and 4b crystallographic positions (Wyckoff's positions). The Ba_2CrUO_6 compound probably has a Pa3 space group with partial ordering between Cr^{3+} and U^{5+} in the 4a and 4b crystallographic positions. (France)

636 STUDY OF THE INTERACTION OF THE OXIDES OF SAMARIUM, YTTRIUM, AND ERBIUM WITH MOLYBDENUM TRIOXIDE. Antonova, S. S.; Shakhno, I. V.; Plyushchev, V. E. (Inst. of Thin Chemical Technology, Moscow). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 14: No. 1, 17-20(1971). (In Russian).

Phase studies of the systems Ln_2O_3–MoO_3 (Ln = Sm, Er, V) were conducted to further understanding of rare earth molybdates. The existence of incongruently melting Ln_2O_3–4 MoO_3 was established. In the system Sm_2O_3–MoO_3 an unstable compound of the formula Sm_2O_3–6 MoO_3 was found which decomposed during annealing to Sm_2O_3–4 MoO_3 and –MoO_3. The structure of the individual compounds was established by x-ray-phase analysis. (tr-auth)

637 HIGH-TEMPERATURE STUDY OF THE STOICHIOMETRY, PHASE BEHAVIOR, VAPORIZATION CHARACTERISTICS, AND THERMODYNAMIC PROPERTIES OF THE CERIUM + OXYGEN SYSTEM. Ackermann, R. J.; Rauh, E. G. (Argonne National Lab., Ill.). J. Chem. Thermodyn.; 3: No. 5, 609-24(Sep 1971).

The cerium + oxygen system was studied by investigating the vaporization behavior of the sesquioxide phase as a function of temperature and composition employing mass effusion and mass-spectrometric techniques. The congruently vaporizing composition of the sesquioxide phase is slightly super-stoichiometric, varying from $CeO_{1.51}$ at 2000°K to $CeO_{1.53}$ at 2300°K. The composition of the lower phase boundary varies from near $CeO_{1.50}$ at 1600°K to $CeO_{1.34}$ at 2000°K. The partial pressures of CeO(g) and CeO_2(g) over the congruently vaporizing sesquioxide were measured over the temperature range 1825 to 2320°K in the presence of both tungsten and rhenium and the partial molar enthalpies were determined for the composition $CeO_{1.52}$. The partial pressures of Ce(g) and CeO(g) over the liquid metal + sesquioxide system were measured over the temperature range 1550 to 2040°K. The equilibrium constants for the isomolecular exchange reactions: Ce(g) + LaO(g) = CeO(g) + La(g) and Ce(g) + YO(g) = CeO(g) + Y(g) were evaluated as a function of temperature. The following thermochemical quantities were determined: $\Delta G^0_f(CeO,g)$/cal mol^{-1} = −37,360 − 10.80 T/K, and $\Delta G^0_f(CeO_2,g)$/cal mol^{-1} = −131,350 + 6.9$_5$ T/K. The standard Gibbs energy of formation of the sesquioxide at the lower phase boundary was calculated as a function of temperature; a calculated value of −281.1 kcal mol^{-1}, corresponding to the composition $CeO_{1.40}$, is about 18 kcal mol^{-1} less negative than that of the stoichiometric sesquioxide $CeO_{1.5}$. (auth)

638 STRUCTURE AND CHEMICAL PROPERTIES OF CERTAIN MIXED OXIDES $MTiO_4$ AND $MTiO_5$. Kahn-Harari, Andree (CNRS, Vitry-sur-Seine, France). Rev. Int. Hautes Temp. Refract.; 8: No. 1, 71-84(Jan-Mar 1971). (In French).

The growth of single crystals of certain mixed oxides with a titanium oxide base, $MO_2 \cdot nTiO_2$, enabled crystallographic and structural studies of the following compounds to be made: $ZrTiO_4$, $HfTiO_4$, $CeTi_2O_6$, and $ThTiO_5$. The existence of several titanium suboxides led to the examination of the behavior of $MO_2 \cdot nTiO_2$ compounds with respect to reduction. Two cases are considered: MO_2 is not reducible under the experimental conditions; MO_2 may be reduced. (France)

639 TRUE STRUCTURE OF THE COMPOUND USi. Laugier, J.; Blum, P. L.; De Tournemine, R. (CEA, Grenoble, France). J. Nucl. Mater.; 41: No. 1, 106-8(Oct 1971). (In French).

Monocrystals of a tetragonal phase of USi with a density of 10.993 possessed a lattice with the parameters: a = 10.61 and b = 24.42. The measured and calculated values of $1/d^2$ show good agreement. X-ray measurements indicated that some samples possessed small quantities of oxygen in the form of UO_2, but at the lower limit of detection. (K.S.W.)

Radiation Effects

Refer also to abstracts 568, 570, 1548, 1550, and 1608.

640 (LB/G-3060) CARBON MATERIALS. Suzuki, Hiroshige; Kimura, Shushichi. Translated by R. A. Scutt (Atomic Energy Research Establishment, Harwell, Eng.), from Zairyo Kagaku; 6: No. 1, 23-32(1969). 27p. Dep. NTIS (U. S. Sales Only).

Properties and crystal structure of graphite and other carbons are discussed. Information is included on defects, radiation effects, physical properties, electric properties, self-diffusion, and chemical properties. (J.R.D.)

641 (RCN-148) PROGRESS REPORT OF THE MATERIALS DEPARTMENT, FIRST QUARTER 1971. Sens, P. F. (ed.) (Reactor Centrum Nederland, Petten). Jun 1971. 78p. Dep. NTIS (U. S. Sales Only).

A description of the progress in the various projects concerning the materials development of water-cooled reactors, sodium-cooled fast reactors, and gas-cooled reactors is presented. (auth)

642 (RT/ING-70(15)) IRRADIATION EXPERIMENTS OF CYRANUM CAPSULES FOR THE STUDY OF THE THERMAL BEHAVIOUR OF THE FUEL RODS. RESULTS OF UO_2 SAMPLES IN PELLETS. Calza Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U.; Rotoloni, P.; Segre, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 55p. (In Italian). INIS.

Irradiation experiments carried out on Cyranum capsules are described. The purpose of these experiments is the study of thermal properties of ceramic UO_2 and UO_2-PuO_2 fuel rods consisting of pellets and vibrocompacted powder. The results of the irradiations of the two first capsules containing pelleted UO_2, in RS-1 Avogrado Reactor at Saluggia, are reported. (INIS)

643 EFFECT OF FISSION PRODUCTS ON THE RATIO OF GRAIN-BOUNDARY ENERGY TO SURFACE ENERGY IN IRRADIATED URANIUM DIOXIDE. Reynolds, G. L.; Beere, W. B.; Sawbridge, P. T. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater.; 41: No. 1, 112-14(Oct 1971).

Observations made on intergranular gas bubbles, in neutron-irradiated UO_2, which enable the ratio of grain-boundary energy (γ_g) to the surface energy (γ_s) to be determined are described. Specimens of UO_2 which had been irradiated to burnups of up to 5×10^{26} fissions/m^3 at temperatures up to 1700°C were fractured and examined using a Cambridge Stereoscan SEM. Annealing these for 72 hr at 1600°C showed no alteration in pore geometry, suggesting that equilibrium had already been attained. Values of tan $\theta/2$ were obtained by measurement of the major and minor axes of the bubbles and apparent values of γ_g/γ_s determined. The values of θ ranged from ~34° to 54°, with a medium of ~47°, resulting in γ_g/γ_s ratio of 1.66 to 1.18, with a median value of 1.35. Two possible major sources of error in the measurements are discussed. (P.C.H.)

644 BURNUP AND TEMPERATURE DEPENDENCE OF SWELLING IN U_3Si. Hastings, I. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater.; 41: No. 2, 195-202 (Nov 1971).

The initial swelling in irradiated U_3Si fuel elements is dependent on burnup and temperature. The volume increase, $\Delta V/V$, was determined as a function of fuel radius in elements which operated at calculated central temperatures between 530 and 600°C, and surface temperatures from 350 to 380°C. Fuel burnups varied from 50 to 990 MWd/tonne U. There was no significant swelling up to at least 270 MWd/tonne U, with the first such indication occurring at 795 MWd/tonne U, where the peak $\Delta V/V$ value was 8%. At 990 MWd/tonne U, the maximum volume increase was 11.5%. At both burnups the swelling was temperature dependent, with the maxima in the range from 500 to 540°C. Transmission electron microscopy of low burnup samples revealed defects which may represent an early stage in the growth of pores responsible for the swelling observed at higher burnups. Previous studies in the range 1500 to 8400 MWd/tonne U have been extended to 14,700 MWd/tonne U; no further volume increase occurred with the additional burnup. (auth)

645 RE-SOLUTION OF FISSION-GAS ATOMS FROM BUBBLES DURING THE IRRADIATION OF UO_2 AT AN ELEVATED TEMPERATURE. Turnbull, J. A.; Cornell, R. M. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater.; 41: No. 2, 156-60(Nov 1971).

Uranium dioxide irradiated at a low temperature was annealed to form a uniform distribution of fission-gas bubbles. Some specimens were re-irradiated to a low dose at 1200°C and the bubble distributions compared with and without this second irradiation. The enrichments of the starting materials were chosen such that specimens received two different doses for the same neutron exposure. Whereas in the higher-dose specimens the original bubble population was completely dispersed, the lower-dose specimens contained remnants of the original bubbles. From these observations an evaluation has been made of the efficiency of the re-solution process. The distribution of fission-gas during irradiation is discussed in the light of the present results. (auth)

646 CHEMICAL EFFECTS OF COMPOSITION CHANGES IN IRRADIATED OXIDE FUEL MATERIALS. Davies, J. H.; Ewart, F. T. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 41: No. 2, 143-55(Nov 1971).

When uranium or plutonium undergoes fission, the mean valency of the resulting fission product mixture may differ from that of the starting material. The use of a computer program to derive the composition of irradiated fuel is described along with ways in which a combination of thermodynamic assessment and direct experiment is used to predict and confirm the consequences of the valency change in irradiated oxide fuels. The experiments consist of an x-ray study of the lattice dilation of uranium dioxide, a direct measurement of the oxygen/metal ratio in plutonium and mixed uranium–plutonium oxides, and electron probe microanalysis of inclusions formed in plutonium oxides. Results show that the lanthanide fission products enter the oxide lattice having the effect that irradiated uranium oxide does not become more oxidizing with burn-up, however plutonium oxide becomes significantly oxygen-rich during fission owing to the shift in the fission yield spectrum. (auth)

647 THERMAL ANNEALING EFFECTS ON ELECTRICAL RESISTIVITY OF REACTOR GRADE GRAPHITE IRRADIATED WITH NEUTRONS AT 250°C AND 350°C. Matsuo, H. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 41: No. 2, 235-7(Nov 1971).

The effects of annealing on the electric conductivity of neutron-irradiated graphite were investigated. It was found that changes in conductivity during annealing are the results of aggregation and dispersion of interstitial atoms, dispersion of interstitial clusters, and migration of vacancies. (J.R.D.)

Plastics and Other Materials

Refer also to abstracts 79, 412, 413, 565–567, and 937.

648 (N-71-32280) RADIATION EFFECTS DESIGN HANDBOOK. SECTION 2. THERMAL-CONTROL COATINGS. Broadway, N. J. (Battelle Memorial Inst., Columbus, Ohio. Radiation Effects Information Center). Jun 1971. Contract NASw-1568. 194p. (NASA-CR-1786). NTIS.

Information relating to steady-state radiation effects on thermal-control coatings is given. The radiation includes nuclear, charged particles, and ultraviolet. The data provide useful information to the design engineer responsible for choosing thermal-control coatings in space applications. (auth) (STAR)

649 POINT DEFECTS AND RADIATION DAMAGE IN ALUMINOPHOSPHATE GLASSES. Bershov, L. V.; Martirosyan, V. O.; Zavadovskaya, E. K.; Starodubtsev, V. A. (Inst. of Geology of Ore Deposits, Petrography, Mineralogy, and Geochemistry Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 417-20(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 476-80(Mar 1971).

Irradiation of phosphate glasses by ionizing radiation (γ radiation or electrons) leads to formation of point defects such as electron and hole centers. The nature of the point radiation defects in these glasses is established from the spectroscopic characteristics (EPR, optical, and thermoluminescent). The radical ions PO_4^{2-} and PO_4^{3-} are interpreted in the framework of the theory of molecular orbitals. It is established that PO_4^{2-} electron centers are responsible for electrodeless discharges observed in electron-irradiated glasses. (auth)

650 THERMAL EFFECTS OF ELECTRON BEAMS. I. Dudek, H. J. (Univ., Karlsruhe, Ger.). Z. Angew. Phys.; 31: No. 5-6, 243-50(1971). (In German).

The thermal effects of electron beams in sheet glass and brass were studied with optical and electron microscopes as a condi-

tion of irradiation. Particularly the beam diameter, irradiation time, and current density were varied. The effects were observed using small current density and long irradiation time (minutes) and high current density and short irradiation time (microseconds). The effects in both cases were bubble formation, piling-up of the surface, and eruption of melt from the irradiation center. The results are discussed in relation to the abrasion of material by the electron beam. (auth)

651 THERMAL EFFECTS OF ELECTRON BEAMS. II. Dudek, H. J. (Univ., Karlsruhe, Ger.). Z. Zngew. Phys.; 31: No. 5-6, 331-7(1971). (In German).

The effects of electron beams in materials described in Part I (Z. Angen. Phys., 31: 243(1971)) are explained with the temporal and local distribution of temperature in materials during the involved heating process. The equation of heat conduction is integrated. The radiation of heat from the surface is neglected. The portion of radiation can be estimated after performing the calculation. The solution is discussed independently of the special properties of materials. Regarding the suitable simplifications, the results of calculation agree with the experimental results from Part I and explain the observed phenomena within a wide range. (auth)

652 STUDY OF Np_x, Th_{1-x}, Mo_2, O_8 SOLID SOLUTIONS Pages, Monique; Freundlich, William (Institut du Radium, Paris. Paris Univ.). Compt. Rend., Ser. C; 272: No. 23, 1861-2(7 Jun 1971). (In French).

The substitution of neptunium in the place of thorium in $ThMo_2O_8$ led to two solid solutions: α orthorhombic and β hexagonal. The $\alpha \rightarrow \beta$ transformation temperature curve was minimum for x = 0.42 and t = 600°C. (France)

653 PRESTRESSED Ba BASED MATERIAL FOR IONIZING RADIATION PROTECTION. Gaillard, Andre French Patent 1,603,362. 13 Apr 1971. Filed 16 Sep 1968. (In French).

A process for manufacturing prestressed concretes containing $Ba(OH)_2$ in the form of prefabricated slabs is presented. The concrete obtained is intended as protective shielding against ionizing radiations. A mixture of Ba with a well defined grain size distribution and concrete is poured into a mold. Pure cement is injected after vibrating the mixture. The mixture is compacted under a pressure of 150 kg/cm^2, and then it is immediately removed from the cast. (France)

PHYSICS (GENERAL)

Astrophysics and Cosmology

654 PLENARVORTRAEGE. (Plenary Proceedings). 34th Physicists Conference, Salzburg, Austria, September 29–October 10, 1969. Stuttgart; B. G. Teubner (1969). 512p. (In German and English). (CONF-690975).

Separate abstracts were prepared for 6 of the 18 papers included. The remaining twelve papers are outside the scope of NSA. (J.W.R.)

For abstracts of individual papers see: 683, 702, 792, 946, 1331, and 1390.

Cosmic Ray Exposure Ages

655 OLIVINES: REVELATION OF TRACKS OF CHARGED PARTICLES. Krishnaswami, S.; Lal, D.; Prabhu, N.; Tamhane, A. S. (Tata Inst. of Fundamental Research, Bombay). Science; 174: No. 4006, 287-91(15 Oct 1971).

A one-step, three-component aqueous etchant was developed for revealing the tracks of charged particles in olivine. The etchant reveals tracks of small cone angle, which are equally well developed in all the crystallographic directions. The scope of fossil cosmic-ray track studies in extraterrestrial samples has thus been increased, because olivine is often an abundant constituent and because it has a higher threshold ionization for track registration and has lower uranium, thorium, and trace-element concentrations as compared with pyroxenes and feldspars. The etchant does not attack any of the principal rock-forming minerals in normal etching time, which allows a nondestructive study of fossil tracks in thin-section mounts. The study of fossil cosmic-ray tracks in olivine is particularly valuable for investigations of very, very heavy cosmic-ray nuclei and for highly irradiated samples such as those found in the lunar regolith. (auth)

Stars

Refer also to abstracts 765, 1075, 1304, and 1383.

656 PHOTOMETRIC OBSERVATIONS OF V1057 CYGNI. Mendoza V., Eugenio E. (Univ. Nacional de Mexico, Mexico City). Astrophys. J.; 169: No. 3, L117-18(1 Nov 1971).

UBVRI photometry and total absorptions of neutral-oxygen lines at λ7774 were obtained for V1057 Cyg. These observations show a high luminosity for this object and give more evidence to affirm that the brightening of V1057 Cyg is a manifestation of the same event that caused the brightening of FU Ori. The infrared excess can be interpreted as the presence of a circumstellar dust cloud; however, the change in spectral type from K to A indicates that an intrinsic change took place, in addition to a partial dissipation of the circumstellar dust cloud. (auth)

657 POSITION MEASUREMENTS OF MAIN-LINE OH/INFRARED STARS. Hardebeck, Ellen G. (California Inst. of Tech., Pasadena); Wilson, William J. Astrophys. J.; 169: No. 3, L123-6(1 Nov 1971).

Interferometer position measurements are reported for five main-line OH emission sources associated with infrared stars. The results of the measurements show that in all cases the 1667-MHz OH emission originates from the stellar position, with typical errors of ±5 to ±15 in. of arc. In addition to the observations of the OH/infrared stars, the position of the main-line OH source OH 2019 + 37 (ON – 2) was measured. This source was found not to coincide with the red star BC Cyg as previous authors have suggested, but instead to be associated with an H II region. (auth)

658 STELLAR EVOLUTION. Taylor, R. J. Sigma Library of Science Surveys. London; Francis Hodgson Scientific Publishers (1970). 24p. £ 1.

A brief account is given of the theory of stellar structure and evolution and of the observations which the theory must explain. The structure and evolution of spherical stars is fairly well understood, although there are important uncertainties in the values of some physical parameters and difficulties arise if the stars become unstable. The study of nonspherical stars is much less advanced. There are mathematical difficulties in the study of rotating, magnetic, and binary stars, and it has recently become clear that there are also unresolved physical difficulties. Ultimately, a star might be expected to cool down and die. Possible end points of stellar evolution are cold stars in which the gravitational attraction is resisted by degeneracy pressure of either electrons or neutrons, but there exists a maximum mass for stars of both these types. According to the presently accepted laws of physics, more-massive stars enter a state of gravitational collapse which takes them to infinitely great densities. (auth) (UK)

659 QUANTITATIVE RESULTS OF STELLAR EVOLUTION AND PULSATION THEORIES. Fricke, K.; Stobie, R. S.; Strittmatter, P. A. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 23-46(1971).

The discrepancy between the masses of Cepheid variables deduced from evolution theory (M_{ev}) and pulsation theory (M_Q, M_ϕ) is examined. It is shown that plausible systematic errors in interior opacity, distance calibration and the $T_{eff}-B-V$ relation can cause substantial errors in the derived masses. The mass M_ϕ obtained for certain Cepheids from the nonlinear pulsation theory through the pulsation period and phase of the secondary hump in the velocity curve is shown to provide a potentially strong constraint on allowable systematic errors in luminosity and effective temperature; some doubts as to the reliability of M_ϕ and the predictions of the nonlinear theory generally are, however, raised. While it appears unlikely that the entire Cepheid mass anomaly can be ascribed to a unique source, there is no difficulty in reconciling the mass discrepancy within the likely errors in physical and empirical data, particularly if doubts about M_ϕ are substantiated. Although mass loss from Cepheid variables may indeed occur it is thus not "required" by the data. The effects of the above systematic errors in other astrophysical contexts (e.g., solar neutrinos, Hyades mass–luminosity relation) are examined and the reliability of previously derived quantities discussed. The extreme sensitivity to input physical data of the evolutionary tracks in the post-red-giant phase is emphasized. In particular the length of the second crossing track is shown to depend strongly on the hydrogen abundance profile in the neighborhood of the shell source. (auth)

660 STARS WITHOUT CIRCULATION. THE EFFECT OF SLIGHT DIFFERENTIAL ROTATION IN THE CONVECTIVE CORE OF UPPER MAIN SEQUENCE STARS. Monaghan, J. J. (Monash Univ., Clayton, Australia). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 47-57(1971).

The effect of relaxing the usual, but poorly justified assumption that convective regions in stars rotate rigidly is examined by considering rotating stars with no circulation. Upper-main-sequence stars are examined in detail and the differential rotation in the radiative envelope is found to depend sensitively on the differential rotation in the convective core. A 0.5% change in the angular velocity in the core from the value for rigid rotation may result in a 30% change in the angular velocity on the equator. Some models are constructed which have zero angular velocity at the equator, but they are found to be unstable near the edge of the star. (auth) (UK)

661 SITE OF THE HELIUM FLASH. Owen, Peter Russell (Univ of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 59-78(1971).

Calculations were made, using the Henyey method, of evolutionary sequences of stars approaching the helium flash and at the time of the flash. Any hydrodynamical effects were neglected. These calculations were made for both Population I and Population II compositions. The effects of nitrogen burning and neutrino energy losses were considered by constructing sequences both with and without these processes. For the Population I composition ($X_{CNO} = 0.02$) the flash is in a shell if there are neutrino losses, whereas for Population II ($X_{CNO} = 0.001$) the flash is initially in a shell but is soon shifted to the center, even though there are neutrino losses. As a result, if there are neutrino losses the character of the flash is different in the two stellar populations. This may result in different evolution subsequently and in different H–R diagrams. The boundary between the two cases is at an initial composition in the range $X_{CNO} = 0.002$ to 0.003. The shift of the flash to the center for Population II stars is a property of the nitrogen burning; it does not occur if nitrogen burning is neglected. Neglect of neutrinos puts the flash at the center. Observed luminosities of stars at the peak of the red giant branch of globular clusters are consistent with theoretical predictions if these stars are making their first ascent of the giant branch. (auth)

662 INTERMEDIATE-BAND PHOTOMETRY OF RR LYRAE VARIABLES. I. DEFINITION AND CHARACTERISTICS OF THE SYSTEM. Jones, D. H. P. (Australian National Univ.,

Canberra). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 79-101(1971).

An intermediate-band photometric system is described, together with the manner of setting it up. Magnitudes and colors of 125 stars are presented. Their relation to each other and to comparable photometric systems is discussed. (auth) (UK)

663 SPECTROSCOPIC RECONNAISSANCE OF A NEW β LYRAE SYSTEM HD 72754. Thackeray, A. D. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 103-23(1971).

HD 72754 (B2 I: pe) is a massive system resembling β Lyr and W Cru spectroscopically and photometrically (secondary invisible) but the two shallow minima (~0.2 m) are probably mainly ellipsoidal in origin. The mass-function derived from the spectroscopic orbit is $8.9_{\odot}$, the period is 33.73 days, and $\alpha \sin i = 90\ R_{\odot}$. (UK)

664 BD+6 DEG 2461 STAR: A HIGH VELOCITY B STAR IN THE GALACTIC NORTH POLE REGION. Berger, J.; Fringant, A. M.; Rebeirot, E. (Centre National de la Recherche Scientifique, Marseille. Centre National de la Recherche Scientifique, Paris. Univ., Marseille). Compt. Rend., Ser. B; 273: No. 4, 217-20(26 Jul 1971). (In French).

The BD + 6° 2461 star has probably been ejected from the galactic disc into the halo with a high initial velocity. Its high residual velocity and its distance from the galactic plane (>5 kpsc) are compatible with its age (estimated to be 2.10^7 years). However, this star could be a sub-luminous star of the halo population. (France)

665 POINT CHARGE IN THE VICINITY OF A SCHWARZSCHILD BLACK HOLE. Cohen, Jeffrey M. (Inst. for Advanced Study, Princeton, N. J.); Wald, Robert M. J. Math. Phys. (N. Y.); 12: No. 9, 1845-9(Sep 1971).

The electrostatic field of a point charge at rest in Schwarzschild space is derived. The solution is used to study the problem of a point charge slowly lowered into a nonrotating black hole. It is found that the electric field of a charge remains well behaved as the charge is lowered and that all the multipole moments except the monopole fade away. It is concluded that a Reissner–Nordstrom black hole is produced. (auth)

666 MATTER IN AN ULTRA-HIGH MAGNETIC FIELD. Kadomtsev, B. B. Usp. Fiz. Nauk; 104: No. 2, 335(Jun 1971). (In Russian).

From Meeting of the Department of General Physics and Astronomy; Moscow, USSR (23 Dec 1970).

Fundamental changes in the physical properties of matter may occur in fields of 10^{12} to 10^{14} oersteds such as could exist in neutron stars. A complete reorganization of electron shells in an atom of atomic number Z would occur where the magnetic field $> Z \times 10^9$ oersteds. Phenomena occurring at other magnetic field strengths are suggested, including ionization and dissociation of molecules and temperature effects. (K.S.W.)

667 SPECTROSCOPIC OBSERVATIONS OF SC STARS. Catchpole, R. M.; Feast, M. W. Mon. Notic. Roy. Astron. Soc.; 154: No. 2, 197-208(1971).

A search was carried out for stars similar to the SC type star UY Cen, and twelve are listed. The six stars newly assigned to the group were selected for observation on the basis of an objective prism survey by Henize. The spectroscopic characteristics defining the group are discussed and the differences from CS stars like R CMi noted. Radial velocities are listed for eight SC stars (making a total of ten with known velocity). A rough estimate of the absolute magnitude ($M_v \sim -2$) and a velocity dispersion of 31 ± 7 km s^{-1} are derived. These figures suggest that the stars are giants of intermediate age and mass. The nine stars of the group which were adequately studied are all lithium-rich, one of them superlithium-rich. In contrast, both the C and S types apparently each contain lithium-poor stars. The frequency of superlithium-rich stars also appears to be higher in the combined SC and CS group (2 out of 18 stars) than in either the C or the S classes. The wavelength of the lithium line in SC stars agrees with that expected for ^{7}Li. Theoretical suggestions by Cameron and Fowler (Astrophys. J., 164: 111(1971)) on lithium production in late-type giants are briefly discussed in the light of these observations. (auth) (UK)

Quasi-Stellar, Radio, and X-Ray Sources

668 OHIO RADIO-SOURCE SPECTRA: LIST II. Wills, Beverley J. (Ohio State Univ., Columbus); Kraus, John D.; Andrew, Bryan H. Astrophys. J.; 169: No. 3, L87-91(1 Nov 1971).

Spectra and improved positions are presented for 30 selected Ohio radio sources. The selection was limited to those sources whose spectra are flat or show an increase in flux density with increasing frequency, or are otherwise complex. Flux densities were measured between frequencies of 0.6 and 10.6 GHz, with some additional measurements at 13.5 GHz. The new position measurements have typical rms errors of ±15 in. (auth)

669 GX 349 + 2 AND GX 340 + 0: LOCATIONS AND X-RAY PULSATION LIMITS. Rappaport, S.; Zaumen, W.; Doxsey, R.; Mayer, W. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 169: No. 3, L93-7(1 Nov 1971).

The celestial positions of GX 349 + 2 and GX 340 + 0 were determined with a precision of better than 1 arc min with a rocket-borne rotating modulation collimator. Limits on periodic x-ray pulsations from these sources were set. (auth)

670 X-RAY SOURCES NEAR THE GALACTIC CENTER OBSERVED BY UHURU. Kellogg, E.; Gursky, H.; Murray, S.; Tananbaum, H.; Giacconi, R. (American Science and Engineering, Cambridge, Mass.). Astrophys. J.; 169: No. 3, L99-103(1 Nov 1971).

X rays emitted from the direction of the galactic nucleus were detected for the first time. The emitting region is of the order of one-tenth as strong as the strongest x-ray emitters in the Sagittarius complex, and is extended by about 2° in galactic longitude. Its spectrum indicates considerable absorption at low energies. A highly variable discrete source close to the galactic center was also observed; it lies about 2° off the galactic plane. (auth)

671 NEW AMMONIA LINES AND SOURCES IN THE GALAXY. Zuckerman, B. (California Inst. of Tech., Pasadena); Morris, M.; Turner, B. E.; Palmer, Patrick. Astrophys. J.; 169: No. 3, L105-8(1 Nov 1971).

Microwave emission from two nonmetastable rotational levels of ammonia (NH_3) was observed in the direction of the continuum source Sgr B2. If the far-infrared rotational lines of NH_3 are optically thin, this observation suggests that the average density of H_2 molecules is $\gtrsim 10^9$ cm^{-3} in this cloud, although other considerations indicate that this density may be as low as $\sim 10^7$ cm^{-3}. Microwave lines from NH_3 were also observed in W3-OH, Orion A, W43, W51, Dr 21-OH, and possibly in Cloud 4, a dense dust cloud. (auth)

672 OBSERVATIONS OF THE $^2\Pi_{\frac{1}{2}}$, J = ½ LINE OF OH AT 4660 MHz IN SAGITTARIUS B2. Gardner, F. F.; Ribes, J. C.; Sinclair, M. W. (CSIRO, Sydney). Astrophys. J.; 169: No. 3, L109-12(1 Nov 1971).

The emission of the 4660-MHz $^2\Pi_{\frac{1}{2}}$, J = ½ OH line from Sgr B2 consists of one narrow feature, possibly two, superposed on a broad emission spectrum some 300 kHz (20 km s^{-1}) wide. The emission is centered 0.5′ north of the position of the 6-cm continuum peak. A narrow emission line at 56 km s^{-1} coincides in velocity with an emission feature at 1667 MHz, whereas the 61 km s^{-1} central velocity of the broad emission is about the same as that of the 1667-MHz absorption maximum and the 109α recombination line. For the broad emission, any maser amplification is probably small, although the absence of similar emission at the F = 1 → 0 and F = 1 → 1 frequencies shows that the relative populations of the $^2\Pi_{\frac{1}{2}}$ substates are very abnormal. (auth)

673 ABSORPTION OF GAMMA RAYS BY PHOTONS IN PULSARS, QUASI-STELLAR OBJECTS, AND OTHER SOURCE OBJECTS. Pollack, J. B. (Ames Research Center, Moffett Field, Calif.). Astrophys. J.; 169: No. 3, L113-16(1 Nov 1971).

Because of pair production, cosmic γ rays above a certain critical energy are destroyed by collisions with low-energy photons before they can escape from their source objects. The critical energy is a sensitive function of the size of the photon-production zone of pulsars and QSOs and can be used for obtaining their sizes. Critical energies for supernova explosions and the Crab Nebula are estimated. (auth)

674 UPPER LIMIT TO CIRCULAR POLARIZATION OF OPTICAL PULSAR NP 0532. Cocke, W. J.; Muncaster, G. W.; Gehrels, T. (Univ. of Arizona, Tucson). Astrophys. J.; 169: No. 3, L119-21(1 Nov 1971).

The circular polarization of optical pulsar NP 0532 was measured at an effective wavelength of 0.5 μ. The measurements were made throughout the light curve with time-resolution windows 2.65 ms wide. No circular polarization was found; the precision about the peak of the main pulse was ±0.07% (rms). (auth)

675 OPTICAL CHANGES IN ELEVEN OHIO RADIO SOURCES WITH UNUSUAL SPECTRA. Folsom, G. H.; Smith, A. G.; Hackney, R. L.; Hackney, Karen R.; Leacock, R. J. (Univ. of Florida, Gainesville). Astrophys. J.; 169: No. 3, L131-5 (1 Nov 1971).

Two and a half years of photographic monitoring of 17 Ohio radio sources with flat or peaked spectra has resulted in the

detection of short-term optical variations in eight of the sources and possible changes in three of the remaining sources. (auth)

676 V/V_m TEST APPLIED TO QUASI-STELLAR RADIO SOURCES. Rees, M. J.; Schmidt, M. (California Inst. of Tech., Pasadena). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 1-7(1971).

The V/V_m test (luminosity volume test) for a sample of quasi-stellar radio sources complete to given radio and optical flux densities was recently discussed critically by Longair and Scheuer (Non. Notic. Roy. Astron. Soc., 151: 45(1970)). Contrary to their claims it is argued that: (i) Proper inclusion of the optical limit increases the significance of the derived nonuniformity of the distribution of 3CR quasars very markedly; (ii) the test was devised to include the effect of unavoidable simultaneous selection according to radio and optical flux density of QSSs, and the fact that the test depends little upon the association of a particular redshift with a particular QSS is incidental; (iii) $\langle V/V_m \rangle$ for those sources in the sample that are radio limited as a measure of the nonuniformity of the space distribution of sources with a maximum value of F_{rad}/F_{opt} — it is not a measure of the evolution of the radio properties of the QSSs; (iv) Longair's paper (Non. Notic. Roy. Astron. Soc., 133: 421(1966)) contains essentially no valid information on the evolution of QSSs. (auth)

677 COMPACT RADIO COMPONENT IN M82. Wilkinson, P. N. (Univ. of Manchester, Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 1P-4P(1971).

Recent radio-link interferometer observations at Jodrell Bank showed that the nearby galaxy M82 contains a small radio component (<0.7 in.), emitting ≈7% of the total radio flux at 1423 MHz, whose spectrum exhibits a low-frequency cutoff. Several explanations for the cutoff in the spectrum are considered. M82 appears to be another example of a galaxy having an "active" core in Heeschen's definition. (auth) (UK)

678 RELATIVISTIC BEAMING OF PULSARS. THE EFFECT OF THE EMISSION SPECTRUM. Smith, F. G. (Univ. of Manchester, Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 154: No. 1, 5P-6P(1971).

The width of the pulses formed by the relativistic beaming effect is shown to depend on the spectrum of the emission process. The analysis is applied to the question of the existence of detectable radiation between the pulses. (auth) (UK)

679 COSMIC RADIOASTRONOMY. Kardashev, N. S.; Pariiskii, Yu. N.; Sokolov, A. G. Usp. Fiz. Nauk; 104: No. 2, 328-31(Jun 1971). (In Russian).

From Meeting of the Department of General Physics and Astronomy; Moscow, USSR (23 Dec 1970).

Radiotelescopes and optical telescopes supplement each other in their respective fields of application, and neither can be said to be capable of replacing the other. The limitations that inhibit the construction of even larger radio telescopes are discussed. An unfolding type of antenna is depicted before and after being placed in orbit. The diameter is 30 m, and the operating wave length is 30 cm. The basic forces are light pressure, tidal forces of the Earth, and centrifugal force during rotation, all of which are much smaller than that of gravitation. For the future, very large mirrors with much greater sensitivity are envisioned, with very long base lines to provide greater angular resolution. A reduction of natural and artificial noises and capacity for very prolonged, continuous measurements are also predicted for the future of radioastronomy. (K.S.W.)

680 INTERACTING RADIO GALAXIES. Hill, J. M.; Longair, M. S. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc.; 154: No. 2, 125-40(1971).

Optical identifications found for the radio sources 3C 129 and 3C 129.1 suggest that they are associated. Similar associations of radio sources were previously found in the Perseus and Coma clusters. 3C 129, the sources 3C 83; 1B and IC 310 in the Perseus cluster, and 5C4.81 in the Coma cluster form a new class of radio galaxy in which the source of energy lies outside the associated galaxy. The energy originates within a nearby galaxy, which is also a radio source. These systems of interacting radio galaxies are relatively common, and as many as one in four of all rich clusters could contain systems of this type. The energy appears to be transmitted in the form of plasma streams with velocities that must be ≳0.01 c. The streams occupy only a small fraction of the space surrounding the active galaxy, and their confinement and stability are attributed to a large-scale ordered magnetic field and an associated intergalactic gas. The existence of these streams supports the hypothesis of an intergalactic medium in clusters. It is suggested that the acceleration of charged particles and the amplification of magnetic fields required to produce the radio emission can be attributed to the effects of turbulence. (auth) (UK)

681 FURTHER DATA ON THE OPTICAL VARIABLE PKS 1514-24. Hunstead, R. W. (Univ. of Sydney). Nature (London); 233: No. 5319, 401-2(8 Oct 1971).

Attention has been drawn to the close agreement in positions between the variable star AP Lib and the radio source PKS 1514-24, and it is important for further investigations that the radio–optical associations be more firmly established by accurate measurements of the radio and optical positions. Radio observations of PKS 1514-24 were made in July and August 1971 using the pencil beam of the cross-type telescope at the Molonglo Radio Observatory, at 408 MHz, and the optical position of AP Lib was measured on glass copies of the Palomar Sky Survey. A comparison of the radio and optical positions showed that they do not coincide, the difference being 4.9″ arc in right ascension. It is considered important, however, to carry out observations at higher resolution to search for possible small-scale structure. Spectral data for PKS 1514-24 indicate a very flat spectrum, and although there is no convincing evidence for variability it seems possible that a secular decrease in 408-MHz flux density has occurred. (UK)

682 OBSERVATIONS OF THE STRUCTURE OF RADIO SOURCES IN THE 3C CATALOGUE. V. THE PROPERTIES OF SOURCES IN A COMPLETE SAMPLE. Mackay, Craig D. Mon. Notic. Roy. Astron. Soc.; 154: No. 2, 209-27(1971).

High-resolution maps of every source in a statistically complete sample of 200 sources were examined for common features. It was found that among the simple double sources the brighter component was, in nearly every case, closer to the associated optical object where one existed, was generally more compact than the fainter component and tended to have a flatter spectrum. Although the structures of the more complex sources are remarkably varied, they have many features similar to those of the simpler sources. The apparent association of complex structure with large physical size and low radio luminosity is shown to arise from observational selection effects. The radio emission from 95% of the sources is concentrated along a narrow band on the sky which passes through the associated optical object if one is visible. The band is generally straight or smoothly curved. There appear to be no structural differences between quasars and radio galaxies. (auth) (UK)

683 PULSARS. Biermann, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 26-51 of Plenarvortraege. Stuttgart; B. G. Teubner (1969). (In German).

From thirty-fourth physicists conference; Salzburg, Austria (29 Sep 1969). See CONF-690975.

Pulsars are surveyed from the standpoint of both experimental observation and theoretical considerations. Especially emphasized is the pulsar of the Crab Nebula as a residuum of the supernova eruption of 1054 A. D. After rejection of white dwarfs and double stars, the neutron-star theory of pulsars is discussed with respect to diameter, density, angular velocity, magnetic field, and pulse duration. The relationship between neutron stars and black holes is mentioned briefly. (H.B.G.)

684 NATURE OF PULSARS. Shklovskii, I. S. Vestn. Akad. Nauk SSSR; No. 8, 55-61(Aug 1969). (In Russian).

At present two out of 40 pulsars, NP 0532 and PSR 0833-45, have been reliably identified as radio nebulae, the residues of supernova explosions; both are characterized by the shortest known periods. The rate of growth of the period, dT/dt, is discussed at some length. Two types of radiation diagrams are described: the "pencil" and the "knife", differing in their anisotropy. The mechanism of radiation by pulsars may be a coherent process, a notion further developed by reference to the pulsar in the Crab Nebula (NP 0532) which emits optical and x radiation in addition to rf, suggesting that a significant quantity of relativistic electrons is present. (K.S.W.)

Solar Phenomena

685 (LBL–45) CONVECTIVE EVOLUTION OF LARGE AMPLITUDE ALFVEN WAVES IN THE SOLAR WIND. Patterson, Blake R. (California Univ., Berkeley, Lawrence Berkeley Lab.). 16 Aug 1971. Contract W-7405-eng-48. 151p. Dep. NTIS.

Thesis.

The convective evolution of large-amplitude Alfvén waves propagating in a nonuniform, streaming plasma modeled after the solar wind is investigated. Observed large- and small-scale properties of the interplanetary medium relevant to this study are reviewed. An idealized solar wind model is developed that neglects solar rotation and has a radial magnetic field. (W.D.M.)

686 (NRC-TT–1485) STRUCTURE OF SOLAR RADIO BURSTS ON A WAVELENGTH OF 10 cm. Yurovskii, Yu. F. Translated by H. R. Hayes for National Research Council of

Canada, Ottawa, from Izv. Krym. Astrofiz. Observ.; 40: 147-60 (1969). 25p. Dep. NTIS (U. S. Sales Only).

The large RT-22 radio telescope at the Crimean Astrophysical Observatory was used to investigate radio bursts on a wavelength of 10 cm. The following conclusions are drawn from the resulting data: (1) A decrease in flux density can either precede or follow the pulse burst. (2) Screening of the radio source of the S-component is observed comparatively frequently. (3) A radio event associated even with a small flare is sometimes complex and consists of a simple impulsive burst, post-burst absorption, and a secondary maximum of emission. (4) Impulsive and secondary bursts originate at different positions on the solar disc. (5) In terms of the investigated characteristics, the secondary burst, which occurs even after a weak flare, is reminiscent of Type-IV radio emission. (auth)

687 NEUTRON THEORY OF CORONA HEATING. Cherg, C. C. (Goddard Space Flight Center, Greenbelt, Md.). Nature (London) Phys. Sci.; 233: No. 41, 112-13(11 Oct 1971).

Reference is made to Fowler and Hashemi (Nature, 230: 518 (1971)) who proposed a neutron theory of solar coronal heating, and it is stated that there are several objections to this theory. It is, for example, difficult to explain the strong influence of the magnetic field on the structure of the solar corona. An observational test of the theory is described, and another difficulty is pointed out, concerned with the high γ-ray flux expected from the neutron-heating theory; so far, no definite detection of solar γ rays has been reported, and it seems unlikely that the high neutron flux required by the theory is generated in the solar atmosphere. (UK)

688 SOLAR-FLARE EFFECTS IN LUNAR XENON. Rao, M. N.; Gopalan, K.; Venkatavaradan, V. S.; Wilkening, L. (Tata Inst. of Fundamental Research, Bombay). Nature (London) Phys. Sci.; 233: No. 41, 114-17(11 Oct 1971).

Low-energy solar-flare protons induce nuclear reactions in Ba isotopes in lunar materials and such interactions give rise to the possibility that a compositionally distinct component exists in lunar Xe, different from the galactic cosmic-ray induced component. A detailed study was made of the Xe data obtained in the stepwise heating experiments on soil and rocks from the Apollo 11 mission, with the specific aim of endeavouring to understand the effects of galactic and solar cosmic rays on the lunar surface. The ratio $^{132}Xe/^{136}Xe$ was plotted against $^{124}Xe/^{136}Xe$. The latter was found to be about 0.8, in good agreement with the high-temperature component of the rock, and indicating that the excess gas observed in this fraction is due purely to high-energy cosmic-ray interactions. The slope of the low-temperature soil fraction indicated solar cosmic-ray production, whilst the high-temperature soil and the low-temperature rock lines indicated a mixture of the two components. The high value of $^{132}Xe/^{136}Xe$ (>3) can be attributed to low-energy solar-proton reactions on specific Ba isotopes. The nuclear reactions and their systematics are discussed. It is concluded that there seems to be strong evidence for the effect of solar cosmic rays in lunar near surface material in the observed isotopic anomalies of ^{132}Xe. Data are also given for some meteorites. (UK)

Galaxies

689 VARIATIONS IN THE 10-μm FLUX FROM NGC 1068. Low, F. J.; Rieke, G. H. (Univ. of Arizona, Tucson). Nature (London); 233: No. 5317, 256-7(24 Sep 1971).

NGC 1068 is one of the most powerful of the extragalactic infrared sources, and with the exception of M82 which is extended, has the highest signal-to-noise ratio at 10 μm. The results of monitoring at 10 μm to look for variations over a period of several years are presented. Older data on NGC 1068 were also reanalyzed. Evidence for variability was considerably strengthened by the later observations, using a new photometer. The variability of NGC 1068, together with the similarities between it and NGC 4151 and 3C 273 in other respects, also greatly strengthens the argument that these sources are also variable. It also appears that the 5- and 3.5-μm fluxes from NGC 1068 have decreased. Limits that can be placed on the sizes of astronomical objects from observations of flux variations are also discussed, and an optically thick shell with a diameter of the order of 3 pc and containing dust at about 400°K would appear to be consistent with the observations of the nucleus of NGC 1068. The reported observations place strong constraints on models for the generation of the far-infrared flux from NGC 1068 by thermal means, and these constraints may hold for many other galactic nuclei that radiate strongly in the infrared. The observations also appear to be the first strong evidence that a significant proportion of the nuclear emission is modulated. (UK)

690 ORIGIN OF GALACTIC ROTATION. Harrison, E. R. (Univ. of Massachusetts, Amherst). Mon. Notic. Roy. Astron. Soc.; 154: No. 2, 167-86(1971).

Current theories on the origin of galactic rotation postulate widely different initial conditions. The assumed initial conditions consist of either density inhomogeneities or spin inhomogeneities, or more generally, a combination of both. When the density contrast $\mu = \delta\rho/\rho$ increases, the Universe is said to be gravitationally unstable; in a similar fashion, when the "spin contrast" $\xi = \omega^2/4\pi G\rho$ increases (where ω is angular velocity) the Universe can be said to be spin-unstable. In the tidal theory it is supposed that ξ is initially zero and that density fluctuations grow because of gravitational instability and then interact to produce galactic spin. In the vortex theory it is supposed that μ is initially zero and that spin fluctuations grow because of spin instability and form into galactic eddies characterized by a spin contrast of $\xi \sim 1$. These cosmogonies are discussed and it is shown that they both encounter difficulties. In particular, they are apparently unable to account for the basic difference between elliptical and spiral systems. A more general cosmogony is then discussed, which takes a less-extreme view of the initial state, and starts from initial conditions consisting of both density and spin inhomogeneities. It is argued that when μ and ξ have initially comparable values, as in the case of the spinning-core theory, the main difficulties inherent in the previous theories are avoided. It is shown in an Appendix that the rotationally induced anisotropy in the expansion is of order ξ. (auth) (UK)

691 DUST IN THE ORION NEBULA. Nandy, K.; Wickramasinghe, N. C. (Royal Observatory, Edinburgh). Mon. Notic. Roy. Astron. Soc.; 154: No. 2, 255-64(1971).

Observations relating to extinction and scattering by dust grains in the Orion nebula are compared with theoretical predictions for graphite–iron–silicate grain mixtures. The available data, including measurements of extinction obtained in the present work, appear to be consistent with the model provided there is a depletion of graphite and iron particles relative to silicates, and an increase in the mean radius of silicate particles as compared with the earlier results for normal H I clouds. The computed average phase functions of the models are in good agreement with recent data on the surface brightness of the Barnard Loop nebula in two ultraviolet wavebands. (auth) (UK)

692 NUCLEI OF GALAXIES. Ambartsumyan, V. A. Vestn. Akad. Nauk SSSR; No. 2, 20-35(Feb 1969). (In Russian).

Nearly all galaxies possess very dense centers or discrete coagulations of matter, which may be termed galactic nuclei. Some striking examples of this definition are depicted and discussed. Seven optical spectra of typical galaxies are considered, predominant colors of portions of the galaxies and notable differences among them being analyzed. The activity of galactic nuclei and quasars represents the release of enormous quantities of energy, often in the nature of an explosion. Several theories of galactic nuclei are set forth, among which there is stated: a nucleus is not formed within an already-existing galaxy, but the galaxy arises as a result of the activity of the nucleus. Two graphs deal with possible relationships between the nucleus type and mass or nucleus type and morphological type of the galaxy itself. (K.S.W.)

Cosmology

693 UNIFORM MODEL UNIVERSES CONTAINING MATTER AND BLACKBODY RADIATION. II. May, T. L.; McVittie, G. C. (Univ. of Illinois, Urbana). Mon. Notic. Roy. Astron. Soc.; 153: No. 4, 491-500(1971).

A method previously developed for this problem is applied to the case of models in which space is spherical. It is also shown how to determine the constants of a model from observational data. The dependence of the temperature of the radiation on the scale factor is found for any model. The temperature is not always inversely proportional to the scale factor but can vary in a more complicated fashion which depends on the law of energy exchange between matter and radiation inherent in the definition of the model universe. (auth) (UK)

694 MEASUREMENT OF THE FAR-INFRARED BACKGROUND RADIATION IN THE NIGHT SKY. Blair, A. G.; Beery, J. G.; Edeskuty, F.; (and others) (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett.; 27: No. 17, 1154-7(25 Oct 1971).

A rocket-borne radiometer measurement of background radiation in the spectral range from 6 to 0.08 mm yielded a flux which corresponds to an equivalent blackbody temperature of $3.1^{+0.9}_{-0.5}$ K. (auth)

695 FLUID-DYNAMICAL STUDY OF THE ACCRETION PROCESS. Hunt, R. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 154: No. 2, 141-65(1971).

A numerical solution is found for a fluid-dynamical treatment of the accretion process in which a gravitating point source is moving through an adiabatic gas (having specific heat ratio $5/3$), the calculations being performed for Mach speeds 0.6, 1.4, and 2.4. Previous accretion theories were based on single particle orbits and would not be valid when collisions are important in the gas, as, for example, in the case of the Galaxy moving through a possible intergalactic plasma. The Mach speed of the Galaxy is probably of order unity and cooling can be neglected for a plasma temperature exceeding 5×10^{5}K, so that the calculations could be relevant to this case although the internal pressure of the Galaxy may be sufficient to retard the inflow appreciably. Other possible applications include stars, star clusters, compact objects or "black holes" moving through an ambient medium. The numerical method used involves time step iteration from an initial state until a steady state is achieved, which gives results accurate to about 4%. The subsonic case shows density and temperature contours strikingly close to those of a stationary source. In the supersonic cases the source is preceded by a bow shock. The accretion rate for each case is calculated and found to be comparable with that derived from previous accretion theory. (auth) (UK)

696 EFFECTS OF VERY-LONG-WAVELENGTH PRIMORDIAL GRAVITATIONAL RADIATION. Rees, M. J. (California Inst. of Tech., Pasadena. Carnegie Institution of Washington, D. C.). Mon. Notic. Roy. Astron. Soc.; 154: No. 2, 187-95 (1971).

The Universe may contain gravitational waves with wavelength 1 to 10 Mpc, of primordial origin, associated with the initial irregularities that give rise to galaxies and clusters. If their energy density ρ_G were comparable with the "critical density" ρ_c ($\sim 2 \times 10^{-29}$ g cm^{-3}), these waves would have interesting effects on the apparent dynamics of groups of galaxies. In a canonical "big-bang" model, which is assumed initially smooth except for small perturbations, it is expected that $\rho_G \ll \rho_c$. However, a "chaotic universe" which resembles a Friedmann model only for redshifts $\lesssim 1000$ could lead to $\rho_G \simeq \rho_c$. It is argued that such a model is compatible with present observations and that it suggests a new interpretation of the microwave background. (auth) (UK)

697 INTERACTION OF GRAVITATIONAL AND ELECTROMAGNETIC FIELDS, OR ANOTHER EFFECT. Ferencz, C.; Tarcsai, G. (Lorand Eoetvoes Univ., Budapest). Nature (London); 233: No. 5319, 404-6(8 Oct 1971).

Reference is made to recent interpretations of certain anomalous effects observed in frequency and interplanetary time-delay measurements in terms of the interaction of gravitational and electromagnetic fields. The proposed interpretations are, for the most part, inconsistent with the general theory of relativity, and often the predicted effects do not match the measurements. It is shown, however, that in the interpretations of the anomalous phenomena there is no need to contradict general relativity and that the different measurements can be reconciled. These phenomena can be quite satisfactorily explained by attributing them to the interaction of the electromagnetic field and the moving inhomogeneous media transversed. The important consideration is that an electromagnetic wave propagating in matter inevitably interacts with the particles of the matter. The particle observes and re-radiates an electromagnetic wave, the characteristics of which are changed according to the theory of relativity. The emphasis in this communication is on the measurement of frequency changes. Amongst matters discussed are the anomalous redshift of the order of 10^{-7} observed near the occultation of Taurus A by the Sun, and the problem of the so-called solar-limb effect. It is concluded that the development of new theories to explain the measured anomalous phenomena is not justified. Such theories will only be required if reliable measurements show anomalous effects differing from the effects of moving media. (UK)

698 ENERGY IN THE UNIVERSE. Dyson, Freeman J. Sci. Amer.; 224: No. 3, 50-9(Sep 1971).

An account is given of the movement of energy in the Universe, insofar as it is understood at the present time. The genesis of the various kinds of energy that are observed on the Earth and in the sky and the processes by which energy is channeled in the evolution of stars and galaxies are discussed. (W.D.M.)

699 LIMITS ON SMALL-SCALE STRUCTURE OF DIFFUSE COSMIC X RAYS. Schwartz, D. A. (Goddard Space Flight Center, Greenbelt, Md.); Boldt, E. A.; Holt, S. S.; Serlemitsos, P. J.; Bleach, R. D. Nature (London) Phys. Sci.; 233: No. 41, 110-12 (11 Oct 1971).

The experimentally measured autocorrelation functions for x rays arising directly or indirectly from the observed distribution of galaxies were compared with the calculations of Wolfe and Burbidge (Nature, 228: 1170(1970)), and their conclusions that the x-ray isotropy is not consistent with the observed superclustering, and probably not with clustering, of galaxies were confirmed. In the experimental work a low-background multi-anode $Xe-CH_4$ proportional chamber employed as the x-ray detector was carried by an Aerobee rocket to an altitude of 91 miles above the White Sands Missile Range on Sept. 21, 1970. The count rates obtained represented mostly diffuse x rays assumed to arise as the integrated effect of discrete sources of constant apparent luminosity distributed uniformly randomly over the sky. It was found that it would take at least 5×10^{5} discrete sources to be consistent with the measured isotropy. The data were consistent with random scatter about zero intrinsic correlation and clearly contradicted supercluster and some cluster models for the origin of the diffuse x rays. The data also act as a constraint to other theoretical calculations that employ different cosmological models or relate the x rays to galaxies in a manner different than the direct proportionality assumed by Wolfe and Burbidge. (UK)

700 COSMOLOGICAL EVOLUTION IN RADIO GALAXIES. Mackay, C. D. (Cavendish Lab., Cambridge, Eng.). Nature (London); 233: No. 5319, 402-4(8 Oct 1971).

Reference is made to Rowan-Robinson (Nature, 229: 388(1971)) who presented evidence that radio galaxies exhibit remarkably strong evolutionary effects with cosmological epoch. Examination of this evidence, however, indicates that, although an evolutionary effect may be present, no reliable estimate of the time scale involved can be made in the proposed way. This is because the mean value of ν/ν_{max}, as defined, is very sensitive to changes in the limiting magnitude assumed for the sample, and also because the redshift corrections which have to be applied to the apparent magnitudes of the fainter radio galaxies, for which the evolutionary effects appear to be strongest, are not sufficiently well known. These effects are considered. An estimation of ν/ν_{max} is made in an Einstein–de Sitter cosmological model for each source in a complete sample known to be a radio galaxy. In the absence of alternative data the redshift corrections of Oke and Sandage (Astrophys. J., 154: 21(1968)) were employed in the relevant calculations; these may not be appropriate for distant radio galaxies, but probably give a good description of the spectral properties of nearer less luminous radio galaxies. It is concluded that Rowan-Robinson substantially over-estimated the rate of evolution in radio galaxies. A reply by Rowan-Robinson is given. (UK)

701 HOT UNIVERSE. Zel'dovich, Ya. B. Vestn. Akad. Nauk SSSR; No. 2, 36-43(Feb 1969). (In Russian).

The Universe is composed chiefly of light quanta and radio-frequency quanta, and not of atoms, protons, and nuclei. A graph of radiation flux vs wavelength of the radiation divides the radiation sources into three groups at inflection points of the curve: common starlight, radio waves, and a central portion of the spectrum, designated T = 2.7°K, which comes from all points of the celestial sphere. The wavelength range of this central portion extends from about 500 cm down to about 0.05 cm, and is partly associated with interstellar dispersal of CN. Extrapolating back into time several billions of years, the temperature may have been 3° or 30°K instead of the present 2.7°K, and the author's graph suggests that the fall in temperature from 10^{14}°K was linear. This thermal history of the Universe is related to the gradual appearance of protons, neutrons, etc. (K.S.W.)

702 EXPERIMENTAL TESTS OF THE GENERAL THEORY OF RELATIVITY. Sexl, R. U. (Univ., Vienna). pp 471-89 of Plenarvortraege. Stuttgart; B. G. Teubner (1969). (In German).

From thirty-fourth physicists conference; Salzburg, Austria (29 Sep 1969). See CONF-690975.

Briefly discussed is the position of the general theory of relativity within the framework of modern physics and its experimental verification. Treated are the special and general theories of relativity, the principal of equivalence, and field equations for gravity. Tests of the general theory of relativity include the redshift of light, light deflection, perihelial rotation, the Shapiro experiment, Earth–Moon distance, and gravitational waves. Although all cosmological problems were excluded from the discussion, it is concluded that Einstein's theory again is one of the most important aspects of modern physics because its foundations have been confirmed with a surprising degree of accuracy as demonstrated by the principal of equivalence, details of the field equations, and the discovery of gravitational waves. (H.B.G.)

Planetary Phenomena

703 GEOLOGICAL PROBLEMS IN LUNAR AND PLANETARY RESEARCH. American Astronautical Society Publication, Volume 25. Proceedings of AAS/IAP Symposium Held at Huntington Beach, California, January 1968 and February 1969, and at Las Vegas, Nevada, April 1968. Green, Jack (ed.). AAS Science and Technology Series. Tarzana, Calif.; American Astronautical Society (1971). 748p.

Papers selected from the three symposia together with some additional ones reflecting acquired Apollo 11 and 12 return data are included. Papers are arranged according to the following categories: sensing techniques; phenomenology; exploration concepts; exploration methods and technology; and general subjects. In all categories, the papers are arranged from the local to the remote, beginning with the Earth–Moon system and then further afield to Mars and beyond. A separate abstract was prepared for one paper in scope for NSA. (W.D.M.)

For an abstract of an individual paper see: 704.

704 WATER ANALYSIS BY A COMBINATION NEUTRON EXPERIMENT. Mills, W. R.; Givens, W. W.; Caldwell, R. L. (Mobil Research and Development Corp., Dallas). pp 185-210 of Geological Problems in Lunar and Planetary Research. /Green, Jack (ed.). Tarzana, Calif.; American Astronautical Society (1971).

A combination neutron experiment is proposed for performing surface and subsurface geochemical analyses on the Moon and planets. The experiment employs a pulsed source of neutrons, a radiation detector, and an instrument to analyze and record the pulses produced by the detector. The detector pulses characterize the time and energy dependence of the radiation produced as a result of interactions between the neutrons and atomic nuclei in the surface material. One of the measurements to be carried out in the combination experiment is a time analysis of the die-away of epithermal neutrons following each burst of fast neutrons produced by the source. A measurement of the rate of epithermal neutron die-away is a sensitive indication of hydrogen. Several experiments were carried out on large rock models that simulate various surface compositions. The water content of these rocks varied from about one tenth to one weight percent. The types of measurements, typical data, and interpretation procedures are discussed. (auth)

705 ENERGY RESOURCES OF THE EARTH. Hubbert, M. King. Sci. Amer.; 224: No. 3, 60-70(Sep 1971).

The flow of energy through the Earth's surface environment is considered in detail. The inward flow of energy has three main sources: solar energy; thermal energy from the interior of the Earth; and tidal energy. (W.D.M.)

Atomic and Molecular Physics

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

706 STUDY OF SECONDARY ELECTRON EMISSION FROM W AND Mo SAMPLES WITH SURFACES OF CONTROLLED CLEANLINESS. Bindi, Robert; Borgnino, Julien; Lanteri, Henri; Martin, Francois (Univ., Nice). Compt. Rend., Ser. B; 272: No. 26, 1465-8(28 Jun 1971). (In French).

Experimental equipment was developed for controlling the cleanliness of the surface of a metal target. When the energy of the incident primary electrons is varied, it is observed that a contaminated target does not yield a secondary emission curve characteristic of the material studied. Secondary emission was studied as a function of the degree of contamination. (France)

707 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 6, NO. 7, 1971. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 66p.

This listing contains 235 articles on various aspects of surface and vacuum physics. (M.O.W.)

708 PROCESS AND DEVICE FOR OBTAINING IONS. Mauve, Henri French Patent 2,041,547. 18 Jan 1971. Filed 29 Apr 1969. (In French).

A process for producing a calibrated ion beam is described. The ions, which are eventually accelerated and focused using a classical ion optics system, are obtained by diffusion across the heated walls of a chamber, which constitutes the ion source. The chamber contains the material to be diffused in either a gaseous or vapor state. The chamber possesses a narrow part of known thickness, which serves as the diffusion region for the material to be ionized. The walls of the narrow part are heated to approximately the ionization temperature of the material so that the ions can be extracted by a relatively low potential. An installation is described that utilizes this procedure. It consists of several ion sources in an enclosure maintained at a controlled degree of vacuum, an ion extraction system, and an optical system defining the trajectory of the ions up to the target. (France)

709 AUGER ELECTRON EMISSION FROM CARBON FOILS IN REFLECTION AND TRANSMISSION. Jacobi, K.; Hoelzl, J. (Technische Univ., Clausthal, Ger.). Surface Sci.; 26: No. 1, 54-60(Jun 1971). (In German).

Carbon foils of different thickness $D(80 \leq D \leq 250$ Å) are bombarded by primary electrons of energy $E_P(100 \leq E_P \leq 2500$ eV). Both the transmitted and reflected energy distributions of secondary electrons are measured. The Auger electron current is determined both in reflection and transmission. A model that describes the emission of Auger electrons is presented. Comparing the experimental results with the model it can be concluded that: (1) The energy dependence of the Auger current measured in reflection is given by the energy dependence of the cross section for ionization of K-electrons. (2) The mean free path in carbon foils for inelastic scattered electrons with an energy of 262 eV is found to be (7.5 ± 1.5) Å. (3) In the transmission experiment, the yield of Auger electrons is found to be larger than predicted by the model. A possible explanation is that primary electrons transverse different path lengths in passing through the exit zone for Auger electrons. (auth)

710 TRANSITION RATES OF THE RESONANT PROCESSES IN Li^+ AND Na^+ ION INTERACTION WITH Li, W, AND Mo SURFACES. Janev, R. K.; Terzic, I. V.; Davidovic, D. M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Surface Sci.; 26: No. 1, 142-50(Jun 1971).

The transition rates of the resonant neutralization and ionization processes of Li^+, Na^+, and Li particles interacting with Li, W, and Mo surfaces are calculated using time-dependent perturbation theory. The bound-state wave functions are taken either as the best one-parameter variational functions or as the Hartree–Fock wave functions. The metallic electron is described properly in the framework of the Sommerfield model for the metal. The effect of the atomic level shift is taken explicitly into account in the derivation of the mean de-activation distance and in the total probability calculations of these processes. (auth)

711 ION DESORPTION CHARACTERISTICS INDUCED BY ELECTRON INTERACTION WITH CARBON MONOXIDE ADSORBED ON RHENIUM. Ford, R. R.; Lichtman, David (Univ. of Wisconsin, Milwaukee). Surface Sci., 26: No. 2, 365-74(Jul 1971).

A study has been made of carbon monoxide adsorbed on polycrystalline rhenium ribbons using electron-probe-surface mass spectrometry, and thermal desorption analysis. For this system, O^+ and CO^+ are found to desorb with comparable efficiency. The results of flash filament experiments with CO on rhenium have been shown to be very similar to those obtained for carbon monoxide on tungsten. Adsorption and desorption studies indicate that CO^+ can be associated with the α phase and O^+ primarily with the lowest binding energy portion of the β phase. The magnitude of these two ion signals has been found to be interrelated. The results obtained on this system may help clarify some of the reasons for the discrepancies observed by different authors for the electron-induced ion desorption products of carbon monoxide adsorbed on tungsten surfaces. (auth)

712 EFFECT OF TEMPERATURE ON THE ANGULAR DISTRIBUTION OF BACKSCATTERED PROTONS IN GOLD AND ZINC. Howe, L. M.; Schmid, S. (Atomic Energy Research Establishment, Harwell, Eng.). Can. J. Phys.; 49: No. 18, 2321-37 (15 Sep 1971).

The influence of thermal vibrations on the angular distribution of the yield of backscattered protons (incident energy 100 keV) was investigated for various axial and planar dips in gold and zinc. The angular distributions were markedly influenced by the crystal temperature and by the depth beneath the crystal surface from which the protons were scattered. In gold, data were obtained over the range 77 to 873°K and the angular width ψ of the distributions was observed to vary exponentially with the root-mean-square vibrational amplitude ρ regardless of the scattering depth. Also in gold, the minimum yield χ_{min} was found to be proportional to ρ^2 for those protons scattered from near the crystal surface but a deviation from this behavior was noted as the depth of scattering increased. In zinc, data were obtained at 77 and 295°K and the magnitude of the observed temperature effect was at least as large as in gold when compared on the basis of

root-mean-square vibrational amplitudes. The experimental results are compared with analytical and computer results of other investigators. (auth) (Canada)

713 ELECTROSTATIC DEFLECTION OF SPUTTERED IONS BY THE INCIDENT SPUTTERING BEAM. Bryce, P.; Richards, J.; Kelly, J. C. (Univ. of New South Wales, Sydney). J. Phys., C (London); 4: No. 13, L263-65(17 Sep 1971).

It is shown that deflections of many degrees can occur in the trajectories of sputtered ions due to electrostatic interaction with the incident ion beam. (auth) (UK)

714 EXCHANGE OF ENERGY BETWEEN COLLECTIVELY INTERACTING BEAMS OF POSITIVE AND NEGATIVE IONS. Gabovich, M. D.; Naida, A. P. (Inst. of Physics, Kiev). JETP Lett. (USSR) (Engl. Transl.); 14: No. 1, 1-3(5 Jul 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 1, 3-6(5 Jul 1971).

The first experimental observation is reported of the effect of exchange of energy between beams of charged particles in a system of mutually penetrating beams of positive and negative ions producing a quasi-neutral synthesized plasma. The different signs of the interacting particles make it possible to analyze separately their velocity distribution functions in the same velocity interval. Mutually penetrating beams of positive and negative hydrogen ions were passed through an interaction chamber with a Hughes–Rojansky analyzer placed at the end of the chamber. The experiment is described, and data permit conclusions to be made concerning the character of variation of the observed beam-particle distribution function. The observed effect of exchange of energy between beams of positive and negative ions is the consequence of a nonlinear interaction resulting from phase bunching of the particles during the course of the development of the two-stream instability. (J.C.W.)

715 SECONDARY ELECTRON EMISSION FROM A NaCl SINGLE CRYSTAL BOMBARDED BY INERT-GAS IONS. Baboux, J. C.; Perdrix, M.; Goutte, R.; Guillaud, C. (Laboratoire d'Optique Corpusculaire, Villeurbanne, France). J. Phys., D (London); 4: No. 10, 1617-23(Oct 1971). (In French).

By using a pulse measurement procedure, a study was made of the electronic emission coefficient and the energy distribution of the secondary electrons when a NaCl single crystal was bombarded by He^+, Ne^+, Ar^+, and Kr^+ ions, the energy of which varied from 1 to 30 keV. The dependence of the coefficient of electronic emission on temperature is interpreted in terms of the interaction of the excited electrons with phonons. (auth) (UK)

Atomic and Molecular Properties

716 SHAPE-RESTRICTED WAVE FUNCTIONS: ELLIPSOIDAL LIMITS FOR GROUND AND EXCITED σ_g STATES OF H_2^+. Katriel, J.; Adam, G. (Nuclear Research Centre, Beer-Sheva, Israel). Chem. Phys. Lett.; 10: No. 5, 533-8(1 Sep 1971).

Ellipsoidal as well as spherical limits for the energies of the $1s\sigma_g$, $2s\sigma_g$, and $3s\sigma_g$ states of H_2^+ were obtained at various internuclear distances. The improvement obtained for the ground-state energy in the ellipsoidal limit is about 40% of the difference between the spherical limit and the exact energy. (auth)

717 STATIC-FIELD-INDUCED SPECTRUM OF HYDROGEN. Buijs, H. L.; Gush, H. P. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 49: No. 18, 2366-75(15 Sep 1971).

The fundamental rotation–vibration band of H_2 induced by an electric field was measured at high resolution using an interferometer with a limit of resolution of 0.006 cm^{-1}. The frequencies and the widths of the absorption features were measured in the density range 1 to 25 amagat, and zero-density frequencies were obtained by extrapolation. The lines exhibit collision narrowing, the minimum width, 0.01 cm^{-1}, occurring at a density of about 2 amagat. A new value, 1.2 cm^3, was obtained for the matrix element of the polarizability. (auth)

718 DIRECT SUM-OF-STATES CALCULATIONS OF THE FREQUENCY-DEPENDENT POLARIZABILITY OF H_2. Dalgarno, A. (Harvard Coll. Observatory, Cambridge, Mass.); Ford, A. Lewis; Browne, J. C. Phys. Rev. Lett.; 27: No. 16, 1033-6 (18 Oct 1971).

The direct sum-over-states method of calculation of dynamic polarizabilities is used to compute the most accurate values for the frequency-dependent polarizability of the ground state yet obtained by ab initio calculations. Accurate values of Rayleigh depolarization ratios are also obtained. A Rayleigh depolarization ratio for Lyman-α radiation (unpolarized light) of 0.0562 is obtained. The feasibility of direct computation of the electric dipole components of the resolvent operator for molecules is established. (auth)

719 OBTAINING THE OPTICAL FIELD ISOTOPE SHIFTS OF A LIGHT ELEMENT. Epstein, Gabriel L.; Davis, Sumner P. (Univ. of California, Berkeley). Phys. Rev., A; 4: No. 2, 464-73(Aug 1971).

The problem of obtaining field isotope shifts for light elements is discussed, and it is shown to be possible, in principle, to extract this information solely from an optical-isotope-shift experiment. Such an experiment was attempted with the even–even calcium isotopes: Ca 40, 42, 44, and 48. It was found that an accuracy of $\sim 10^{-5}$ cm^{-1} in the measurements would be required to effect the separation. Lacking that accuracy, the conditions under which optical-isotope-shift measurements may be combined with those of other isotope-shift experiments were considered. The even–even calcium isotopes fulfill these conditions, allowing the desired separation of optical mass- and field-effect isotope shifts to be accomplished by drawing on the results of muonic x-ray and electron-scattering experiments. The optical field-effect shifts thereby found are shown to corroborate the picture of the calcium nuclei derived from those experiments. A correlation between the relative isotope shift and the binding energy per nucleon, proposed by Gerstenkorn, is shown to apply to the calcium isotope shifts. (auth)

720 ATOMIC SPECTROSCOPIC APPLICATIONS OF NUCLEAR ACCELERATORS. Berenyi, Denes (Nuclear Research Inst., Debrecen, Hungary). Fiz. Szemle; 19: No. 7, 199-203(Jul 1971). (In Hungarian).

The use of Van de Graaff type and other accelerators in beam–foil spectroscopy is reviewed. This approach was first proposed about 7 years ago; since then two international conferences have been organized and another is scheduled for 1972. Accelerated ions of various atoms, such as C, O, etc., become more strongly ionized and excited after they pass through thin foils; this results in the emission of light. If one side of the target chamber is made of a transparent material, the light becomes visible and may be analyzed by an optical spectrograph. The method may be used to determine the lifetime of atomic levels. The purity of the ion beam may be improved by using deflecting magnets. Beam–foil spectroscopy may be used to determine the spectral distribution of the emitted light, its wavelength and level lifetimes; the Stark effect and the Lamb shift may also be studied by examining the effect of external electromagnetic fields. Further experimental improvements will yield better spectral lines by eliminating poor geometry and scattering effects. The technique is suited to the study of the solar corona and determination of the abundance of elements in the Universe; it shows promise as a tool in thermonuclear research. (TTT)

721 NONZERO MAGNETIC FIELD LEVEL-CROSSING OF $^3\Pi_u$ HYDROGEN MOLECULAR LEVELS EXCITED BY ELECTRON IMPACT. Baltayan, P.; Nedelec, O. (Univ. Grenoble, France). Phys. Lett.; 37A: No. 1, 31–2(25 Oct 1971).

The fine structure of the 1s 3p $^3\Pi_u$, $\nu = 0, 1, 2, 3$, $N = 1$ levels of parahydrogen was measured by nonzero-magnetic-field level crossing. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

722 INVESTIGATION OF THE CONDENSED STATE OF MATTER WITH THE AID OF POSITIVE μ MESONS. Gurevich, I. I. Usp. Fiz. Nauk; 104: No. 2, 335-6(Jun 1971). (In Russian).

From Meeting of the Department of General Physics and Astronomy; Moscow, USSR (23 Dec 1970).

Polarized μ^+-meson beams are assumed to decelerate in their passage through matter to atomic electron velocities, capture an electron, and form a muon atom. These enter into chemical reactions or are imbedded in a lattice. Measurement of the polarization of μ^+ mesons is determined by the two parameters: the lifetime of the meson, and the frequency of depolarization of a muon electron. This brief review of recent work discusses the use of the Zeeman effect, EPR, and dipole–dipole interaction in connection with meson work. (K.S.W.)

Collision Phenomena

Refer also to abstract 988.

723 INTERFERENCE PHENOMENA IN ATOMIC SCATTERING. Nikitin, E. E.; Ovchinnikova, M. Ya. Usp. Fiz. Nauk; 104: No. 3, 379-412(Jul 1971). (In Russian).

General methods for describing elastic and inelastic processes at energies and scattering angles such that the potential in the usual sense may be considered a perturbation are summarized.

This so-called high-energy approximation is applicable for comparatively slow collisions. Interference phenomena for elastic scattering of atoms with a typical interaction potential (attraction at great distances and repulsion at small) are discussed. The phenomena are taken from the wave amplitude interference studies of de Broglie. Resonance processes for which there is no connection with adiabatic potentials are reviewed, and inelastic processes are depicted as the interference of two independent waves. Finally, inelastic processes are examined with a localized coupling between terms. Here, nonadiabatic interaction between various electron states appears localized in comparison to the narrow regions of change of the internuclear distance. The end of this survey is devoted to the theory of anomalous differential cross sections near the threshold of inelastic processes. 108 references. (K.S.W.)

724 CALCULATION OF CROSS SECTIONS FOR PENNING IONIZATION: $He^*(2^1S,2^3S) + H(1^2S)$. Cohen, J. S.; Lane, N. F. (Rice Univ., Houston, Tex.). Chem. Phys. Lett.; 10: No. 5, 623-5(1 Sep 1971).

Cross sections for ionization of hydrogen atoms by metastable helium atoms are calculated using the best published values for the complex potential. The present cross section for the singlet metastable is quite different from previous determinations. The validity of the JWKB approximation is verified. (auth)

725 PENNING ELECTRON SPECTRA FROM IONIZATION OF HYDROGEN ATOMS BY $He(2^1S)$ AND $He(2^3S)$ METASTABLES. Hotop, H.; Illenberger, E.; Morgner, H.; Niehaus, A. (Univ., Freiburg i. B.). Chem. Phys. Lett.; 10: No. 5, 493-7(1 Sep 1971).

Separate Penning electron spectra were measured resulting from the ionization of H atoms by $He(2^1S)$ and $He(2^3S)$ metastables in thermal collisions. From these results potential parameters of the diatomics $He(2^1S)-H(^2S)$ $(^2\Sigma)$ and $He(2^3S)-H(^2S)$ $(^2\Sigma)$ as well as the cross-section ratio $\sigma(\text{singlet})/\sigma(\text{triplet})$ are derived. (auth)

726 PHASE-SPACE MODEL FOR $He^+ + N_2$ REACTIONS: CONSIDERATION OF DISPERSION AND SHORT RANGE FORCES. Fullerton, D. C.; Moran, T. F. (Georgia Inst. of Tech., Atlanta). Chem. Phys. Lett.; 10: No. 5, 626-30(1 Sep 1971).

An intermolecular potential-energy function with polarization, dispersion, charge-quadrupole, and short-range repulsive contributions is incorporated into the statistical phase-space description of He^+-N_2 reactions. Statistical phase-space cross sections for reactions of ions with kinetic energies less than 1 eV are adequately computed using the polarization potential alone. The inclusion of dispersion and short-range repulsive terms in the interaction potential is necessary for a detailed description of the reaction cross section over a wide range of kinetic energies. (auth)

727 ROLE OF PROTON–PROTON INTERACTION IN THE (p^+,H) ELECTRON-TRANSFER COLLISION. Chen, Joseph C. Y.; Kramer, Paul J. (Univ. of California, San Diego, La Jolla). Contract AT(04-3)-34. Phys. Rev. Lett.; 27: No. 14, 899-901 (4 Oct 1971).

The resonant (p^+, H) electron-transfer cross section is calculated in the first-order Faddeev–Watson multiple-scattering approximation. The result shows that the cross section lies between the Brinkman–Kramers and Jackson–Schiff cross sections and approaches the Jackson–Schiff cross section in the high-energy limit. If the contribution coming from the on-shell Coulomb cuts is neglected, the cross section approaches the Brinkman–Kramers cross section asymptotically in the high-energy limit. Arguments are presented that the on-shell-cut contribution should be included in the calculation of the electron-transfer amplitude. (auth)

728 ESTIMATION OF THE COUPLING MATRIX ELEMENTS FOR ONE-ELECTRON-TRANSFER SYSTEMS. Olson, R. E. (Stanford Research Inst., Menlo Park, Calif.); Smith, F. T.; Bauer, E. Appl. Opt.; 10: No. 8, 1848-55(Aug 1971).

A semiempirical method, based on a correlation of ninety-nine calculated or measured values, is suggested for estimating the coupling matrix elements H_{12} needed in a Landau–Zener calculation. The procedure is applicable to one-electron-transfer problems, such as charge transfer and ion–ion recombination calculations, and requires only a knowledge of the crossing distance R_x and readily available atomic properties such as ionization potentials, electron affinities, and atomic energy levels. Possible applications and limitations of the method are discussed. (auth)

729 PROGRAM FOR CALCULATING RELATIVISTIC ELASTIC ELECTRON–ATOM COLLISION DATA. Yates, A. C. (Indiana Univ., Bloomington). Comput. Phys. Commun.; 2: No. 4, 175-9(May-Jun 1971).

The program A SCAT calculates angular distributions and spin-polarization distributions of electrons scattered elastically by atomic targets within the framework of the static field approximation. The radial Dirac equations are cast into Schroedinger form, and the resulting second-order differential equation is solved by using the modified form of the Numerov algorithm. The partial-wave series are then summed directly. As written, the program handles any scalar potential written as a sum of Yukawa terms, but it is easily modified to treat other functional forms or numerical tables. The program is written in FORTRAN IV for CDC 6600. (A.G.W.)

730 ELECTRON TRANSFER IN COLLISIONS OF LOW-ENERGY NEGATIVE OXYGEN IONS WITH O_2. Roche, A. E.; Goodyear, C. C. (Univ. of Liverpool). J. Phys., D (London); 4: No. 10, 1513-19(Oct 1971).

Total cross sections for the production of slow negative ions in collisions of O^- and O_2^- ions with O_2 molecules were measured for incident ion energies in the range 4 to 100 eV, using a single-collision beam technique. Over the whole energy range for O_2^- and for O^- energies greater than approximately 35 eV the dominant contribution to the cross section is attributed to simple charge transfer, whereas, for low-energy O^- beams, elastic scattering has an important effect. The results are compared with those of Rutherford and Turner (J. Geophys. Res., 72: 3795(1967)) and Bailey and Mahadevan (J. Chem. Phys., 52: 179(1970)), and reasons are suggested for the large discrepancies that appear in cross sections for O^- in O_2. (auth) (UK)

731 COMPOUND STATES IN ATOMIC PHYSICS. Hersenberg, A. (Yale Univ., New Haven). Phys. Bull. (London); 22: 521-6(Sep 1971).

When during the scattering of a particle by a complex system — an electron by an atom for example — the projectile is temporarily captured, the resulting complex is called a compound state or resonance. The three mechanisms for the formation of a compound state are described. Wave functions of compound states, in particular shape resonances are considered. The question of scattering is reviewed; electron–atom collisions, electron scattering from helium atoms, and electron–molecule scattering are considered. Instances of repulsive and attractive compound states are given. One of the most exciting developments of compound-state theory in atomic physics, the recombination reaction $H + H \rightarrow H_2$, is discussed. It is stated that, apart from the basic physics of compound states in atomic collisions, an impressive list of processes of practical importance in which compound states on the atomic or molecular level play a key role is building up, and examples are given. (UK)

732 RELATIVISTIC EFFECTS IN LOW-ENERGY ELECTRON SCATTERING FROM ATOMS. Walker, D. W. (Univ. of Melbourne). Advan. Phys.; 20: No. 85, 257-323(May 1971).

Recent relativistic calculations on low-energy elastic scattering of electrons from atoms are reviewed. Two aspects are emphasized: mathematical transformations and numerical methods used in the solution of the Dirac equation and the summation of the partial wave series; and the results of relativistic calculations, in particular the behaviour of the cross sections and spin polarizations for different atoms, different energies of the incident electron, and in different approximations. The effects of the screening of the nucleus by the atomic electrons, electron exchange (including the use of approximate exchange potentials), and the distortion of the atom by the incident electron are discussed. Detailed results for cross sections and spin polarizations are given for mercury and the inert gases. The differences arising from use of the Dirac equation instead of the Schrödinger equation are considered. (auth) (UK)

733 HIGH ENERGY APPROXIMATION: I. PROTON–HYDROGEN CHARGE TRANSFER. Geltman, S. (National Bureau of Standards, Boulder, Colo. Univ. of Colorado, Boulder). J. Phys., B (London); 4: No. 10, 1288-98(Oct 1971).

The proton–hydrogen ground-state charge-transfer process is studied in a first-order approximation in which the proton–proton interaction is treated as belonging to the unperturbed part of the problem. This results in the appearance of a Coulomb wave rather than a plane wave in the final state of the T matrix. The result is a cross section that lies between the Brinkmann–Kramers and Jackson–Schiff results, with the high-energy limit of $0.810\ \sigma_{BK}$. (auth)

734 HIGH-ENERGY APPROXIMATION. II. HYDROGEN ATOM EXCITATION BY ELECTRONS. Geltman, S.; Hidalgo, M. B. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. Univ. of Colorado, Boulder). J. Phys., B (London); 4: No. 10, 1299-1307(Oct 1971).

The cross sections for the excitation of the 2s, 2p, and 3s states of hydrogen by electron impact are evaluated at high energy in a

first-order approximation in which the interaction between the incident electron and target proton is represented by a Coulomb-wave final state in the T matrix. In the usual Born approximation this interaction has a vanishing contribution because of the orthogonality of the atomic states. The evaluated total cross sections converge to the Born result at high energies, but the differential cross sections at large angles show marked disagreement with the Born approximation and reasonable agreement with experiment. It is concluded that for nonforward inelastic scattering the Born approximation does not converge to the correct result in the high-energy limit. (auth) (UK)

735 APPLICATION OF A SIMPLIFIED SECOND BORN APPROXIMATION TO THE SCATTERING OF ELECTRONS AND PROTONS BY HELIUM ATOMS. Holt, A. R. (Univ. of Essex, Eng.); Hunt, J.; Moiseiwitsch, B. L. J. Phys., B (London): 4: No. 10, 1318-31(Oct 1971).

The elastic scattering of electrons by helium atoms and the excitation of helium to the 2^1S and 2^1P states by electron and proton impact are investigated using a simplification of the second Born approximation in which the terms arising from the coupling to the 1^1S, 2^1S, and 2^1P states are evaluated exactly and those arising from couplings to all the higher singlet discrete states and continuum states are estimated by employing the closure formula. For the case of the elastic scattering of electrons, allowance for couplings to all intermediate states of the helium atom produces differential-cross-section curves that differ considerably from those obtained using the first Born approximation by the introduction of a strong peak in the forward direction for each electron-impact energy, in good accordance with the experimental data and with previous calculations that took account of polarization. On the other hand, for the case of the $1^1S \rightarrow 2^1S$ and $1^1S \rightarrow 2^1P$ electron-impact excitations, when allowance for couplings to all intermediate states is made by using the closure formula, it is found that the resulting differential and total cross sections are quite close to the first Born approximation curves, again in accordance with the experimental data at moderate and high energies. However the effect of making allowance for couplings to all intermediate states in the case of proton impact is found to be important, particularly for proton energies in the neighbourhoods of the maxima of the total excitation cross sections and for proton energies below the positions of the maxima. (auth) (UK)

736 MEASUREMENT OF CROSS SECTIONS FOR DETACHMENT FROM H^- BY A METHOD EMPLOYING INCLINED ION AND ELECTRON BEAMS. Walton, D. S.; Peart, B.; Dolder, K. T. (Univ. of Newcastle upon Tyne, Eng.). J. Phys., B (London): 4: No. 10, 1343-8(Oct 1971).

A technique employing inclined beams of electrons and ions was developed and used to measure cross sections of the reaction $H^- + e \rightarrow H + 2e$ for interaction energies between threshold (0.75 eV) and 30 eV. The magnitudes of the cross sections agree closely with results obtained by Peart et al. (NSA 25: 1003), for energies greater than 12.5 eV, with normally inclined beams. At energies close to 14.2 eV a pronounced structure was observed in the detachment cross section. This could be attributed to the formation of a state of H^{2-} with a lifetime of order 10^{-15} sec. (auth) (UK)

737 QUANTUM-MECHANICAL CALCULATIONS OF ELECTRON-IMPACT BROADENING OF ISOLATED ION LINES. Barnes, K. S. (University Coll., London). J. Phys., B (London): 4: No. 10, 1377-87(Oct 1971).

Quantum mechanical calculations were carried out for the broadening by electron impact of the lines Mg^+ 3p–3s at 2802 Å and Ca^+ 4p–3d at 8542 Å. The line-broadening function is averaged over the resonances in the elastic scattering of the electrons by both the initial and final states of the ion. The results agree well with recent semiclassical calculations for the width but badly with those for the shift. This is due to the omission from the electron scattering calculations of states that contribute to the polarization of either the upper or lower levels of the line. Comparison with experiment is inconclusive in view of the uncertainty in the experimental determination of density and the small number of experimental points. (auth) (UK)

738 COLLISIONAL QUENCHING OF METASTABLE DEUTERIUM. Dose, V.; Hett, W. (Univ., Zurich). J. Phys., B (London): 4: No. 10, L83-5(Oct 1971).

The cross section for collisional quenching of metastable deuterium in collisions with molecular hydrogen was measured for velocities between 0.35×10^6 and 8×10^6 cm sec^{-1} using a time-of-flight method. Results are compared with theoretical predictions and other experimental work in this velocity range. (auth) (UK)

739 EXCITATION OF Li AND Na ATOMS BY ELECTRON IMPACT USING OCHKUR'S APPROXIMATION. Felden, M. M.; Felden, M. A. (Laboratoire de Physique, Nancy). Phys. Lett.; 37A: No. 1, 88-90(25 Oct 1971).

The Born and Ochkur approximations are used to calculate the excitation cross sections for e–Li and e–Na. The radial wave functions used for the valence electron are the Bates and Damgaard coulombic functions. (auth)

Atomic Theory

Refer also to abstract 990.

740 NEW ATOMIC STRUCTURE THEORY AND BEAM FOIL SPECTROSCOPY. Sinanoglu, Oktay (Yale Univ., New Haven. Orta-Dogu Teknik Univ., Ankara). Rev. Mex. Fis.; 20: No. 2, 143-60(1971).

The theory of atomic structure is divided in this article into three phases: Hartree–Fock theory, electron correlation, and the relativistic part. The Hartree–Fock theory, the older traditional theory, is reviewed briefly. Development of the electron-correlation theory began in the 1960's. The essential features of this theory, including various approaches to both ground and excited states, are summarized. The relativistic part is considered to be still in the future. The importance of beam–foil spectroscopy as a new experimental tool that can be used to check the predictions of theory is pointed out. (A.G.W.)

741 NEW VERSION OF A GENERAL PROGRAM TO CALCULATE ANGULAR MOMENTUM INTEGRALS IN ATOMIC STRUCTURE. Hibbert, A. (Queen's Univ., Belfast). Comput. Phys. Commun.; 2: No. 4, 180-90(May-Jun 1971).

The program WEIGHTS NEW VERSION corrects some errors and limitations and improves the efficiency of a previously published program WEIGHTS (Comput. Phys. Commun., 1: 359(1970)). These programs express the matrix elements of the two-electron interaction of the hamiltonian as a weighted sum of radial Slater integrals. The main difference between the two versions is that the present version makes use of average energy expressions where possible. The program is written in FORTRAN IV for ICL 1907. (A.G.W.)

742 NEW APPROACH TO CORRELATION ENERGIES IN ATOMS. Sharma, C. S.; Bowtell, G. (London Univ.). Nature (London) Phys. Sci.; 233: No. 37, 34-5(13 Sep 1971).

It is stated that the theory developed is applicable to all atoms, but for simplicity it is illustrated by considering only the ground state of He. The theory involves a generalisation of Linderberg's method (Phys. Rev., 121: 816(1961)) into a powerful tool for the exact evaluation of the second-order Hartree–Fock energy of any state of any atom. The results are actually obtained in terms of the corresponding results obtained for certain eigenstates of He, and this emphasises the importance of eigenstates of He in this kind of approach, where solutions for complex atoms are built up from solutions obtained for the He eigenstates. The mathematical treatment is described. (UK)

Cosmic Radiation

Refer also to abstracts 321, 994, and 1046.

743 ORIGINS OF COSMIC RAYS. Cowsik, Ramanath; Price, P. Buford (Univ. of California, Berkeley). Contract AT(04-3)-34. Phys. Today; 24: No. 10, 30-8(Oct 1971).

It is postulated that white dwarfs may be the source of the bulk of the cosmic rays. Some of the properties of the three classes of cosmic rays (nuclei, electrons, and electromagnetic component) are discussed in an attempt to explain the mystery of their origins. Topics covered include: the nuclear component; energy spectra; fields, matter, and cosmic rays; distribution in time and space; composition at sources; transuranic cosmic rays; electron component; residence time in the Galaxy; electrons as probes; positrons; intergalactic electrons; supernovae; pulsars; and white dwarfs. (W.D.M.)

744 OBSERVATION OF GAMMA RAYS DUE TO ELECTRON-PAIR ANNIHILATION IN THE ATMOSPHERE OF EARTH. Nakagawa, Shigeo; Tsukuda, Masahiro; Okudaira, Kiyoshi; Hirasima, Yo; Yoshimori, Masato (Rikkyo Univ., Tokyo). Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 7: No. 1, 292-9(Mar 1971). (In Japanese).

The 0.511-MeV γ rays produced by annihilation of electron–positron pairs was measured by balloon experiment for four years

from 1967 to 1970. Intensity of the 0.511-MeV γ rays should be ascertained since it constitutes background for the measurement of extraterrestrial γ rays. Results of the authors' measurement, repeated three times, were in good agreement with each other within measuring error. Rate of production of the 0.511-MeV γ rays in an atmospheric column of 1 cm^2 cross section turned out to be 18.5 ± 4.7 photons cm^{-2} sec^{-1}. The rate of production of 0.511-MeV γ rays expected from energy-balance of the cosmic radiation was also calculated theoretically, and was 36.2 photons cm^{-2} sec^{-1} per atmospheric column of 1 cm^2 cross section. (auth) (Japan)

745 MECHANISM OF RADIO EMISSION FROM EXTENSIVE AIR SHOWERS. Prescott, J. R.; Hough, J. H.; Pidcock, J. K. (Univ. of Calgary, Can.). Nature (London) Phys. Sci.; 233: No. 41, 109-10(11 Oct 1971).

An experiment is described that was devised to determine the relative contribution of geomagnetic charge separation in the production of radio pulses from extensive air showers, using an antennae array and a set of five scintillation counters at the Dominion Radio Astrophysical Observatory, Penticton, British Columbia; the experiment was conducted between Nov. 1968 and April 1969 and between Oct. 1969 and Jan. 1970. The scintillation counters determined the direction of the incident shower, the location of its axis, and the shower size. On theoretical grounds the chief contribution would be expected to be from the geomagnetic effect, and the dominance of the geomagnetic effect was clearly demonstrated. The mean shower size was ~10^6 particles and the mean distance of the shower core from the antennae centre was 20 m. A contribution from some other mechanism amounting to 14 ± 6% was indicated. (UK)

Direct Energy Conversion

Refer also to abstract 1557.

746 PROCEDURE FOR CROSSING THE BOUNDARY LAYER IN A MAGNETOHYDRODYNAMIC GENERATOR. A GENERATOR UTILIZING THIS PROCEDURE. Klein, Georges; Sadoune, Joseph (to Compagnie Generale d'Electricite). French Patent 2,040,820. 11 Jan 1971. Filed 14 Apr 1969. (In French).

A magnetohydrodynamic generator whose electrodes are provided with a means of emitting a jet of hot liquid metal is described. When the potential difference between the two electrodes varies between 5 and 30 volts, the current density associated with an electrode varies hyperbolically between 3×10^3 A/m^2 and 1×10^5 A/m^2. (France)

747 PROSPECTS FOR ECONOMIC PRODUCTION OF ELECTRICITY WITH MHD GENERATORS. Pohl, F. Brennst.-Waerme-Kraft; 23: No. 7, 335-9(Jul 1971). (In German).

A survey is given of the 5th international symposium on magnetohydrodynamic energy production which was held at Munich in 1971. The operation principles of MHD generators are discussed and schematically presented. Special emphasis is given to the open cycle MHD process. The present status of development is described for various countries in the Western as well as in the Eastern world. The closed-cycle MHD process with noble gas and liquid metal as fluids is briefly discussed. It is concluded that for West Germany, because of its economic structure, only the open-cycle MHD process promises successful industrial application for electricity generation. (H.B.G.)

748 ENERGY CONVERSION IN ELECTRO-OSMOTIC EFFECTS. Srivastava, M. L. (Univ. of Gorakhpur, India); Rastogi, S. C. Indian J. Technol.; 9: No. 2, 70-1(Feb 1971).

The efficiency of energy conversion in electro-osmotic effects (electro-osmosis and streaming potential) was examined. The dependence of efficiency on the properties of the permeant and the membrane has been studied. (auth)

749 NUMERICAL SOLUTION OF THE KROOK-MODEL BOLTZMANN EQUATION FOR A PLASMA DIODE. Whipple, Elden C. Jr. (National Oceanic and Atmospheric Administration, Boulder, Colo.); Parker, Lee W. Phys. Fluids; 14: No. 11, 2368-72(Nov 1971).

The Boltzmann equations for both ions and electrons with the Krook collision model are solved self-consistently with Poisson's equation for a plasma diode by a discrete-ordinate technique. The charged-particle mean free path may be arbitrary compared to either the electrode spacing or the Debye length. Solutions for a diode with an electrode spacing that is both one ion mean free path (approximately $2^{-\frac{1}{2}}$ electron mean free paths) and one Debye length show that it is possible to fit the ion results by a solution of the diffusion–mobility equation with an approximate extrapolated end point. The electron results may not be so fitted because of their large change in temperature. Results for an "electrons only" diode agree well with a computer simulation calculation by Burger. Some results are also presented for a potential-well problem involving trapped orbits which can only be populated by collisions. (auth)

750 CONVERSION OF ENERGY. Summers, Claude M. Sci. Amer.; 224: No. 3, 148-60(Sep 1971).

This discussion of practically all known types of energy converters includes a comparison of their efficiencies, showing a range from 5% for the ordinary incandescent lamp to 99% for large electric generators. A major need is a kind of energy source that does not add to the Earth's heat load. (L.M.T.)

751 OPERATION OF A REFRACTORY CERAMIC ELECTRODE IN A MAGNETOHYDRODYNAMIC (MHD) GENERATOR. Gokhshtein, Ya. P.; Safonov, A. A. (Inst. of High Temperatures, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 582-5(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 671-6(Apr 1971).

When specimens of 0.85 ZrO_2–0.15 Y_2O_3 operate in an atmosphere of air in the absence of thermal shock, at current densities exceeding the critical level, cracks form as a result of electrolysis within the ceramic, leading to mechanical destruction of the electrode of an MHD generator. The sharp rise in the resistivity of the specimen can be used to judge the onset of the appearance of cracks inside the ceramic; this sign can be used to monitor the state of an electrode during operation in an MHD generator. The resistivity of the specimen during electrolysis can conveniently be measured with the aid of two probes in different cross sections (near the plasma and current lead). (auth)

752 INTERACTION OF THE FARADAY AND HALL MODES IN AN MHD GENERATOR. Ogiwara, H. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Energy Convers.; 11: No. 4, 155-9(Dec 1971).

Starting from the generalized representation of the performance of an MHD generator channel, the characteristics of a Faraday generator are discussed and the following results obtained: (1) The generating characteristics are limited by leakage currents in the channel. (2) The finiteness of the electrode segmentation results in an increase of internal resistance. This is coupled to the Hall effect. (3) The leakage resistances decrease the output voltage. Especially, the Hall voltage is reduced by the distribution of the conductivity in the normal direction. (4) The Hall voltage develops even in the Faraday open-circuit condition, due to the leakage currents. This Hall voltage is explained by boundary layer resistances and leakage resistances. (auth)

Fluid Physics

753 HEAT TRANSFER TO THE INSULATOR WALL OF A LINEAR MGD ACCELERATOR. Cochran, Robert A. (Shell Pipe Line Corp., Houston, Tex.); Fay, James A. J. Heat Transfer; 93: No. 3, 264-70(Aug 1971).

An experimental investigation of the rate of heat transfer to the insulator wall of a quasi-steady magnetogasdynamic accelerator is described. The experiments were conducted in an accelerator section attached to the end of a shock tube using argon as the test gas. The measurements are compared with a Hartmann boundary-layer analysis, which correlates the data within the experimental scatter. Based on this theory, estimates of the current shorting through the boundary layer and energy fluxes to the wall are made and compared with the accelerator's overall performance. (auth)

754 RAYLEIGH–TAYLOR INSTABILITY OF COMPRESSIBLE FLUIDS IN THE PRESENCE OF A VERTICAL MAGNETIC FIELD. Ariel, P. D. (Malaviya Regional Engineering Coll., Jaipur, India). Appl. Sci. Res. (The Hague); 24: No. 4, 294-304(Jul 1971).

The influence of a vertical magnetic field on the stability of a compressible, inviscid fluid of variable density is investigated. The solution is characterized by a variational principle. Based on it, an approximate solution for the fluid of exponentially varying density confined between two planes is obtained. The magnetic field is found to have a stabilizing influence on the unstable arrangement. Also, the effect of a magnetic field on the angular frequency of oscillations of the waves generated in stable arrangement is considered. (auth)

755 EFFECT OF PERIODIC PARIETAL DEFORMATIONS ON THE FLOW OF AN INCOMPRESSIBLE ELECTRICALLY

CONDUCTING FLUID BETWEEN TWO COAXIAL CYLINDERS IN A RADIAL MAGNETIC FIELD. Borzeix, Jacques; Chagneau, Francis (Univ., Poitiers, France). Compt. Rend., Ser. A; 273: No. 3, 190-3(19 Jul 1971). (In French).

A method for determining and calculating the magnetic field, the current function and the pressure in an electrically conducting fluid flow is proposed. The method of small perturbations is used. The fluid flows between two coaxial tubes having periodic parietal deformations and situated in a radial magnetic field. (France)

756 MAGNETOHYDRODYNAMIC MACH CONES. Yen, David H. Y. (Michigan State Univ., East Lansing). Phys. Fluids; 14: No. 11, 2549-51(Nov 1971).

The problem of general fast-hyperbolic magnetohydrodynamic flows past a point source is considered. Questions on the geometry of the magnetohydrodynamic Mach cones and on the nature of the singularities of the disturbances carried on such cones are studied. (auth)

757 SURFACE-TENSION-DRIVEN CONVECTION UNDER THE SIMULTANEOUS ACTION OF A MAGNETIC FIELD AND ROTATION. Takashima, M.; Namikawa, T. (Osaka City Univ.). Phys. Lett.; 37A: No. 1, 55-6(25 Oct 1971).

Linear stability theory is applied to the problem of surface-tension driven convection when a magnetic field and rotation are simultaneously present. It is shown that the overall behavior of a fluid is similar to that for the case of buoyancy-driven convection. (auth)

758 MAGNETOHYDRODYNAMIC FREE CONVECTION DUE TO AN INSTANTANEOUS HEAT SOURCE. Chawla, S. S. (Indian Inst. of Tech., Kharagpur). J. Phys. Soc. Jap.; 31: No. 5, 1560-6(Nov 1971).

The effect of a uniform normal magnetic field upon the free convection from a vertical wall, when an instantaneous heat flux is released from the wall, is considered. Solutions for small and large times are obtained using Laplace transform techniques. In the ultimate state a steady streaming, confined within the Hartmann layer, emerges. At all stages of the motion the shearing stress at the wall is less than its corresponding value in the non-magnetic case, provided the thermal diffusivity is less than the magnetic diffusivity. (auth)

Upper Atmosphere Physics

Refer also to abstract 981.

759 (N-71-32436) PLASMA PARAMETER β IN THE MIDNIGHT MAGNETOSPHERE: FROM THE NEAR-EARTH PLASMA SHEET TO THE PLASMAPAUSE. Sugiura, Masahisa (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jul 1971. 20p. (NASA-TM-X-65640; X-645-71-280). NTIS.

Magnetometer observations on OGO-B and estimates of plasma energy density based on proton and electron flux measurements on the same satellite were used to evaluate the plasma parameter β (the ratio of plasma energy density to the magnetic field energy density) in the magnetosphere near midnight. The observations were made near the dipole equator. It was shown that, near midnight, β normally exceeded unity just outside the plasmapause even during magnetically quiet periods. Existence of a peak in β near the inner edge of the high-β region appeared to be a part of the structure of this plasma region. The proton belt was not the main cause of the equatorial depression of the magnetic field in the inner magnetosphere, because the distribution of ΔB, defined as the deviation of the scalar B from the magnitude of a reference field, was entirely different from that expected from the proton belt. Both the radial distribution and the magnitude of β were highly variable from one pass to the next over a time span of approximately two days. (auth) (STAR)

760 (N-71-32477) SEVERAL COMMENTS CONCERNING A RECENTLY PROPOSED MAGNETOSPHERIC MODEL. Frank, L. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Nov 1970. Contract NAS5-0974. 15p. (NASA-CR-119780; UI-70-57). NTIS.

Recent observations of the plasmas in the distant polar magnetosphere are interpreted in terms of a new model of the magnetosphere. These measurements demonstrated that magnetosheath plasma gains direct access to the magnetosphere through two wide bands along the sunlit magnetopause at high latitudes, one each in the northern and southern hemispheres. The region in the sunlit magnetosphere to which the magnetosheath plasma has direct access is designated as the polar cusp. The spatial relationship of the polar cusp and the plasma sheet in the magnetotail is shown. (auth) (STAR)

761 (N-71-32479) ELECTRON AND POSITIVE ION DENSITY-ALTITUDE DISTRIBUTIONS IN THE EQUATORIAL D REGION. Aikin, A. C.; Goldberg, R. A.; Somayajulu, Y. V. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1971. 27p. (NASA-TM-S-65655; X-625-71-308). NTIS.

Three simultaneous rocket measurements of D-region ionization sources and electron and ion densities were made in one day. Electron-density profiles for solar zenith angles of 53.2, 27.8, and 48.3° are displayed. The profiles are found to be quite similar to those reported for midlatitudes under quiet conditions. Using simultaneous measurement of the x-ray flux together with NO ionization estimates based on recent measurements of NO by Meira (1971) and $O_2(1\Delta g)$ ionization rates by Huffman et al. (1971), the ion pair production function is computed. It is demonstrated that the charged-particle distribution can be explained using this production function and an effective recombination coefficient compatible with recent laboratory measurements of the dissociative recombination coefficient for electrons with hydrated cluster ions. (auth)

762 (WRE-TM-A-193-AP) PREDICTIONS OF THE OCCURRENCE OF IONOSPHERIC SPREAD F AT NUI DAT. Treharne, R. F. (Weapons Research Establishment, Salisbury (Australia)). Dec 1970. 8p. Dep. NTIS (U. S. Sales Only).

Predictions are made of the occurrence of spread F at Nui Dat, South Vietnam; these predictions are based on the work of K. Tao of Japan. At this locality spread F occurs primarily in the evening and is strongest in the May-to-July and August-to-October quarters. (auth)

763 POWER SPECTRAL ANALYSES OF AURORAL LIGHT AND X-RAY PULSATIONS. Scourfield, M. W. J.; Parsons, N. R. (Univ. of Calgary, Alberta). Can. J. Phys.; 49: No. 17, 2195-2201(1 Sep 1971).

Higher-frequency components in auroral light pulsations are shown to be considerably damped relative to similar components in associated x-ray pulsations. This effect can be explained in terms of velocity dispersion of electrons of different energies whose flux in the loss cone is modulated simultaneously in a localized region some 10^5 km out along auroral-zone field lines. An alternative explanation is suggested that involves an energy-selective modulation mechanism that could be acting quite close to the ionosphere. (auth) (Canada)

764 VERIFICATION OF THEORY ON WEAK TURBULENCE RELATING TO THE SEQUENCE OF DIFFUSE PLASMA RESONANCES IN SPACE. Oya, Hiroshi (Goddard Space Flight Center, Greenbelt, Md.). Phys. Fluids; 14: No. 11, 2487-99(Nov 1971).

An interpretation of the sequence of diffuse plasma resonances observed by space probes (Alouette 2 and ISIS-1 satellites) is developed in terms of wave-particle nonlinear interaction in a weakly turbulent plasma, including the electrostatic electron cyclotron harmonic wave instability. Observations and theory indicate that the center frequency f_{Dn} of the diffuse plasma resonance $[nf_H < f_{Dn} < (n+1)f_H$ and $f_{Dn} < f_T]$ and the center frequency of the electrostatic wave resonance $[nf_H < f_{Qn} < (n+1)f_H$ and $f_T < f_{Qn}]$ satisfy the condition of the wave-particle nonlinear interaction with the $2f_H$ resonance according to the condition $2\pi[2f_H - (f_{Qn+2} - f_{Dn})] = [k(f_{Qn+2}) - k(f_{Dn})] \cdot v$, where nf_H, f_T, and v are the cyclotron harmonic frequency, the upper hybrid frequency, and the thermal velocity of the plasma, respectively; and k(f) is a wave vector as a function of a frequency f. The weaker diffuse plasma resonance branch observed at f_{Dn1} (where $f_{Dn1} > f_{Dn}$) satisfies the condition $2\pi[f_H - (f_{Qn+1} - f_{Dn1})] = [k(f_{Qn+1}) - k(f_{Dn1})] \cdot v$. The longest time duration of the f_{Dn} resonance coincides with the most favorable condition for the electrostatic electron-cyclotron harmonic wave instability, which is obtained by solving the dispersion equation obtained for a linear approximation of the kinetic wave equation for the warm magnetoactive plasma. The electrostatic field due to the transmission of the intense rf pulse produces plasma turbulence involving nonlinear wave-wave interactions and temperature anisotropy which leads to the instability; this instability supplies energy to the turbulence. The f_H and $2f_H$ nonlinear wave-particle interactions in the turbulence heat the plasma to maintain the temperature anisotropy, which lengthens the time over which the cyclotron harmonic wave instability conditions prevail; this process can be thought of as a feedback system. The results also indicate that the f_H, $2f_H$, and f_{Qn} waves are dependent on the f_{Dn} resonance generation. (auth)

765 SCIENTIFIC MEETING OF THE DEPARTMENT OF GENERAL PHYSICS AND ASTRONOMY OF THE ACADEMY OF

SCIENCES, USSR, IN CONJUNCTION WITH THE DEPARTMENT OF NUCLEAR PHYSICS. Conference Held in Moscow, December 23–24, 1970. Usp. Fiz. Nauk; 104: No. 2, 323-36(Jun 1971). (In Russian). (CONF-701218).

Eight reports were delivered at the sessions and included the topics: resonance protons; polarized auroras; radio astronomy; long radiowaves; aureole refraction; ultra-high magnetic fields; μ^+-mesons; and x-ray optics. A separate abstract was prepared for each of the five items in scope. (K.S.W.)

For abstracts of individual papers see: 666, 679, 722, 766, and 767.

766 RESONANCE PROTONS AND THE ELECTRIC FIELD IN THE EARTH'S MAGNETOSPHERE. Gurevich, A. V.; Tsedilina, E. E.; Shcherbakov, V. P. Usp. Fiz. Nauk; 104: No. 2, 323-5(Jun 1971). (In Russian).

From Meeting of the Department of General Physics and Astronomy; Moscow, USSR (23 Dec 1970).

Data have appeared on the behavior of protons with energies of 5 to 50 keV in the magnetosphere during magnetic storms. The magnetic field of the dipole at great distances from the Earth is noticeably distorted owing to the effect of the solar wind. The trajectory drift of "resonance" protons was determined in the asymmetric portion of the magnetic field (plane of the geomagnetic equator), since the effects of the dipole field and of the Earth's rotation are mutually cancelled. The strength of the electric field in the ionosphere after ejection of electrons was calculated and plotted for 25° geomagnetic latitude and longitude = 0. (K.S.W.)

767 POLAR AURORA AND THE RESONANCE CONCEPT OF A MAGNETIC STORM. Gal'perin, Yu. I. Usp. Fiz. Nauk; 104: No. 2, 326-8(Jun 1971). (In Russian).

From Meeting of the Department of General Physics and Astronomy; Moscow, USSR (23 Dec 1970).

The processes occurring in the magnetosphere during a magnetic storm (the so-called substorms) are discussed. After a period of calm in the solar wind, there appears a corpuscular stream in interplanetary space as a result of processes occurring on the Sun. These particles are able to penetrate the magnetosphere into the plasma layer. As a result of a loss of energy of quasi-trapped particles, the resonance particles may be stored in potential wells, arising on the nocturnal side of the magnetosphere, establishing a cloud of quasi-trapped hot protons and ions with energies near 10 keV. An azimuthal asymmetry of quasi-trapped protons appears. In the case of prolonged "pumping" of the magnetosphere by resonance particles from the solar wind, the generation of substorms may be repeated. (K.S.W.)

768 IAGA SYMPOSIUM ON SOLAR REGULAR DAILY GEOMAGNETIC VARIATIONS, HELD IN POTSDAM, GERMANY, 23–29 APRIL 1970. Gerlands Beitr. Geophys.; 80: No. 2-3, 91-272(1971). (CONF-700447).

A separate abstract was prepared for each of the eighteen papers presented. (W.D.M.)

For abstracts of individual papers see: 769–786.

769 INTERACTIONS BETWEEN THE IONOSPHERE AND THE MAGNETOSPHERE FOR SOLAR REGULAR DAILY GEOMAGNETIC VARIATIONS. Matsushita, Sadami (National Center for Atmospheric Research, Boulder, Colo. Univ. of Colorado, Boulder). Gerlands Beitr. Geophys.; 80: No. 2-3, 91-110(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

Concerning the ionospheric interaction with the magnetosphere during quiet periods, effects of electrostatic fields in the dynamo region (90 to 150 km) on the magnetosphere are presented. Based on reasonable models of anisotropic electrical conductivities and solar-thermal diurnal-tidal wind system in the dynamo region, a distribution of the electrostatic field for Sq in equinoctial months during moderate sunspot periods is estimated. This dynamo-region electrostatic field may be communicated to the magnetosphere along the Earth's magnetic lines of force without appreciable attenuation. The communicated electrostatic field distribution in the magnetosphere is deduced, and drift motions of magnetospheric plasma particles caused by the coupling of the Earth's magnetic and the electrostatic fields are computed. An outward drift flow in the daytime and an inward flow at night occur with a speed of a few meters per second to several hundred, increasing with the distance from the Earth. Concerning the magnetospheric effects on the ionosphere during relatively quiet periods, contributions to the Sq field by the electric currents at the magnetopause and the neutral sheet in the magnetospheric tail are reviewed, and speculations of quiet-time ring current are presented. The polar-equivalent overhead current system is also reviewed from the standpoint of magnetospheric effects on the dynamo region. Furthermore, using the same but reversed mapping procedure of dynamo-region fields along magnetic lines of force, magnetospheric electrostatic field effects on the dynamo region are discussed. Highly localized geomagnetic variations during fairly quiet periods can be explained by this effect. Also, a possibility of producing Sq-type electric currents in the dynamo region by the plasmapheric electrostatic fields caused by magnetospheric convections is examined. (auth)

770 MORPHOLOGY OF Sq-FIELD DYNAMICS. Mishin, Vilen Moysseevich (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Irkutsk, USSR). Gerlands Beitr. Geophys.; 80: No. 2-3, 111-16(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

Regular and irregular morphological properties of the dynamics of midlatitude Sq fields are discussed, especially the (regular) UT and annual changes of the main Sq field and the (irregular) fluctuations of this field. Antisymmetrical field-aligned currents are proposed. (auth)

771 CALCULATION OF CURRENT SYSTEMS OF DAILY GEOMAGNETIC VARIATIONS. Stone, Derek John (Univ. of Exeter, Eng.). Gerlands Beitr. Geophys.; 80: No. 2-3, 117-28 (1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

During the IGY a larger number of simultaneous observations were made than at any previous time, and most recent analyses use these data. The four main analyses of the IGY data by MATSUSHITA and MAEDA, MISHIN and co-workers, SUGIURA and HAGAN, and PRICE and STONE are discussed and the aims and methods compared. These analyses have been based on the use of ground-based observatory data only. Now, however, satellite data are available from OGO-2 and OGO-4, and future determinations of current systems using more realistic three-dimensional models of current flow will clearly need to make full use of these additional data. (auth)

772 ATMOSPHERIC DYNAMO: THEORETICAL INVESTIGATIONS OF DIFFERENT MODELS (A REVIEW). Wagner, Christian-Ulrich (Zentralinstitut fuer Solar-Terrestrische Physik, Potsdam, Ger.). Gerlands Beitr. Geophys.; 80: No. 2-3, 129-40(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

A short discussion of the basic equations of the atmospheric dynamo in the quasi-stationary and stationary approximation is presented. A review of the first attempts to develop three-dimensional models of the atmospheric dynamo is given. The approximations made in the different models are compared without going too far into the mathematical details of the analysis. (auth)

773 SOME REMARKS ON THE NEW κ INDEX. Fanselau, Gerhard (Zentralinstitut Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 80: No. 2-3, 141-4(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

For characterizing the variability of the geomagnetic activity during a day a new index is discussed. The statistical features of this index are considered. They show a clearly marked dependence on geomagnetic latitude. An influence of the mean activity can be stated too. This influence varies with the geomagnetic latitude, showing a maximum under the equatorial electrojet. (auth)

774 HARMONIC RESIDUUM OF Sq. Fanselau, Gerhard (Zentralinstitut Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 80: No. 2-3, 145-50(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

The harmonic residuum, which means the residuum of an arbitrary function related to a harmonic expansion, is used for a discussion of the Sq. Mean deviation and correlation coefficients are considered. Especially the harmonic residuum of the third order leads to new aspects for the selection of quiet days. (auth)

775 MORPHOLOGY OF THE LUNAR DAILY GEOMAGNETIC VARIATION AND ITS RELATION TO S. Malin, Stuart Robert Charles (Inst. of Geological Sciences, Hailsham, Eng.). Gerlands Beitr. Geophys.; 80: No. 2-3, 151-4(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

The relevance of studies of the lunar daily geomagnetic variation, L, to the problem of the ionospheric dynamo is discussed. An account is given of some recent and current work on the morphology of L, which forms part of a major project initiated by Sydney Chapman. (auth)

776 CONDUCTIVITY AND emf-DYNAMO NONUNIFORMITIES; FIELD-ALIGNED CURRENTS IN THE MAGNETOSPHERE. Matveev, M. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Irkutsk, USSR). Gerlands Beitr. Geophys.; 80: No. 2-3, 155-70(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

Electrostatic fields in the ionosphere and current systems responsible for geomagnetic Sq variations are calculated taking into account electric currents along the geomagnetic field, caused by the ionospheric emf dynamo on the basis of a simplified model of the ionosphere and the magnetosphere. It is noted that large-scale field-aligned currents in the stationary approximation should greatly contribute to a current system of Sq variations. The derived density of these currents, generated in the ionospheric E layer, is $\sim 10^{-12}$ amp/cm^2. Based on the calculations of the above fields and currents for a number of simple three-dimensional models, conclusions are drawn about the properties of these fields and currents, which can be summarized. A two-dimensional equation is obtained for large-scale electrostatic fields, which results from the three-dimensional dynamo equation. (auth)

777 DYNAMO THEORY OF Sq VARIATIONS. Mishin, V. M.; Basarzhapov, A. D.; Matveev, M. I.; (and others) (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Irkutsk, USSR). Gerlands Beitr. Geophys.; 80: No. 2-3, 171-84(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

Possibilities to describe regularities of Sq-field dynamics (the effect of the Earth's diurnal rotation on Sq currents, their annual variations) within the framework of the classical two-dimensional dynamo theory are investigated in terms of an improved electroconductivity model of the ionosphere and the magnetic field. A conclusion is drawn that the above regularities (unlike the average Sq-field characteristics) are not embedded within a two-dimensional theory. It is shown that consideration of field-aligned magnetospheric currents within the framework of a three-dimensional dynamo theory enables one to give a satisfactory description of Sq fields both the average fields and in the dynamics. (auth)

778 DERIVATION OF THE DYNAMO EQUATIONS. Moehlmann, Diedrich (Zentralinstitut Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 80: No. 2-3, 185-94(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

Equations describing the atmospheric-dynamo processes are derived and discussed. The derivation is based on Maxwell's equations and OHM's law with an anisotropic and nonsymmetric electric conductivity tensor. Properties of the dynamo equations are investigated. The dynamo equations are modified for ionospheric conditions. (auth)

779 SPECIAL SOLUTIONS OF THE DYNAMO EQUATIONS. Moehlmann, Diedrich (Zentralinstitut Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 80: No. 2-3, 195-8(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

A generalized Rayleigh–Ritz method for the solution of the dynamo equations for the electrostatic potential is derived. Simple three-dimensional models are discussed qualitatively for ionospheric equatorial conditions and for the coupling of the northern and southern hemispheres. (auth)

780 ANALYSIS OF THE GEOMAGNETIC DIURNAL VARIATION DURING THE INTERNATIONAL GEOPHYSICAL YEAR. Parkinson, W. D. (Univ. of Tasmania, Hobart, Australia). Gerlands Beitr. Geophys.; 80: No. 2-3, 199-232(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

A program for the automatic analysis of diurnal variation has been developed and applied to solar quiet-day variations observed during the IGY. The Fourier coefficients of the means of International Quiet Days from about 50 observatories were analyzed as functions of latitude and longitude by the Gram–Schmidt method and those that were not statistically significant were discarded. Some terms depending on longitude as well as local time were included. The zero of the variation field was taken as the local midnight value at each observatory. Current functions corresponding to the external primary field and the internal induced field were calculated for every six hours and for the four seasons. The current pattern is found to be influenced by the asymmetry of the main field. The complex ratio of internal to external potentials agrees fairly well with those derived from previous analyses, but there is an apparently significant difference between the 24- and 12-hour harmonics not previously reported. (auth)

781 ELECTROCONDUCTIVITY OF THE NONUNIFORM IONOSPHERE. Popov, Georgii Vassilevich (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Irkutsk, USSR). Gerlands Beitr. Geophys.; 80: No. 2-3, 233-8 (1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

An averaging of OHM's law for anisotropic plasma is made for revealing some influence on currents of ionospheric plasma density irregularities. It is shown that effects caused by irregularities are rather great and change the effective electroconductivity of the ionosphere. These effects are dependent on UT. The effect of the transverse electric fields in generating field-aligned currents is marked. (auth)

782 SOME SUGGESTIONS FOR FURTHER S_R STUDIES. Price, Albert T. Gerlands Beitr. Geophys.; 80: No. 2-3, 239-42 (1971).

Some suggestions are made about further theoretical S_R studies. They deal with the two- and three-dimensional treatment of the dynamo theory (infinite thin and finite thick layers), with the inverse problem of the determination of the wind fields from geomagnetic variations, and finally with mutual and self-induction effects. (auth)

783 MEASUREMENTS OF ELECTRIC FIELDS IN EQUATORIAL AND MEDIUM LATITUDES DURING TWILIGHT USING BARIUM-ION CLOUDS. Rieger, Erich (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Gerlands Beitr. Geophys.; 80: No. 2-3, 243-52(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

Measurements of the ionospheric electric field at low and medium magnetic latitudes using barium-ion clouds are summarized. The measured field strengths range from 0.3 to about 4.0 V/km. The field vectors are pointing preferentially southward during evening twilight and northward during morning twilight on the northern hemisphere at midlatitudes. At the equator, the vertical component exceeds the horizontal one by a factor of about 3. Here the drifts are west and upward in the evening and east and downward in the morning. The implications of the observations on the Sq current are discussed, and evidence for the dynamo action of the atmosphere is derived in some cases, preferentially by evening experiments. At the geomagnetic equator the ionospheric current appears to be driven by the electric polarization field. (auth)

784 NIGHT-TIME IONOSPHERIC CURRENTS IN THE REGION OF THE EQUATORIAL ELECTROJET. Sastry, T. S. Gopalakrishna (Physical Research Lab., Ahmedabad, India). Gerlands Beitr. Geophys.; 80: No. 2-3, 253-8(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

Rocket measurements of the equatorial electrojet current system near Thumba (India) during day and night time show that currents of significant intensity flow in the ionosphere during magnetically quiet nights. But from the data available it is impossible to determine the height, the direction, or the nature of the night-time current system. There is some evidence that the currents flow westward, opposite to the daytime electrojet. At lower altitudes there was an eastward jet interpreted as remaining daytime current. On magnetically quiet days with strong electrojet the jet flow continues till late in the night and gives rise to an enhanced night-time level of H variation. (auth)

785 CALCULATION METHOD OF EQUIVALENT CURRENT SYSTEMS BY THE DATA OF GROUND OBSERVATIONS OF THE GEOMAGNETIC FIELD. Zaitsev, A. N.; Molchanov, O. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Irkutsk, USSR). Gerlands Beitr. Geophys.; 80: No. 2-3, 259-67(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

The total current intensity and the current-density distribution at a height of 115 km and parallel to a profile on the Earth's surface were calculated. This was done by assuming different models of the magnetic horizontal intensity variation along this profile. Symmetric and asymmetric models were used. It is shown that an asymmetric model agrees fairly well with the observational data of the electrojet. (auth)

786 REMARK ON THE DETERMINATION OF IONOSPHERIC WINDS AND FIELD-ALIGNED MAGNETOSPHERIC CURRENTS FROM SURFACE OBSERVATIONS OF S_R. van Sabben, Dingenis (Royal Netherlands Meteorological Inst., De Bilt). Gerlands Beitr. Geophys.; 80: No. 2-3, 268-9(1971).

From Symposium on solar regular daily geomagnetic variations; Potsdam, Germany (23 Apr 1970).

By using four or more different analyses of the equivalent cur-

rent system at consecutive but reasonably spaced UT epochs of a magnetically quiet day, it should be possible in principle to solve the 8 unknown velocity components per conjugate-point pair from the (at least) 4 times 2 sets of equations. (W.D.M.)

787 POSSIBLE RELATIONSHIP BETWEEN SUBSTORM ELECTRON DRIFT AND COSMIC-NOISE ABSORPTION ON THE MORNING SIDE OF THE AURORAL ZONE. Abdu, M. A. (Univ. of Western Ontario, London). J. Atmos. Terrest. Phys.; 33: No. 11, 1703-10(Nov 1971).

Calculation of the energy loss in the atmosphere of drifting electrons during auroral substorms shows a harder energy spectrum for the electrons reaching the morning side than those near the midnight side of the auroral zone. The possibility of detecting the precipitation effect of these electrons on the morning cosmic noise absorption events is examined by studying the variation of the exponent n in the expression absorption αf^{-n} in relation to the position of the magnetic-bay current system which accompanies such absorption events. (auth) (UK)

788 DYNAMICAL BEHAVIOUR OF THE NIGHTTIME IONOSPHERE AT ARECIBO. Nelson, G. J.; Cogger, L. L. (Arecibo Observatory, Puerto Rico). J. Atmos. Terrest. Phys.; 33: No. 11, 1711-6(Nov 1971).

A survey of 130 nights of incoherent scatter data collected at Arecibo between October 1965 and June 1969 revealed the presence of two persistent dynamical features in the nighttime ionosphere. The first general characteristic is a downward motion of the F layer which commences near midnight on 85% of the nights and results in a height change of typically 50 to 100 km. A study of ionograms from other stations showed that the local time of commencement increases linearly with magnetic latitude in both hemispheres; however, it occurs less frequently with increasing latitude. The second dynamical feature is an upward motion which follows the downward motion and occurs on 60% of the nights. The timing of the two events is unrelated and the rise sometimes begins simultaneously over large areas in both hemispheres. It does not occur at the geomagnetic equator. Possible mechanisms for these events are discussed briefly. Changes in the intensity of the 6300 Å night airglow emission are related to the variations in recombination rate resulting from these motions. (auth) (UK)

789 CHARACTERISTICS OF THE MIDLATITUDE TROUGH AS DETERMINED BY THE ELECTRON DENSITY EXPERIMENT ON ARIEL III. Tulunay, Y.; Sayers, J. (Univ. of Birmingham, Eng.). J. Atmos. Terrest. Phys.; 33: No. 11, 1737-61(Nov 1971).

Criteria were established to identify midlatitude troughs by computer analysis of Ariel III electron density data and were used to study the variations of such troughs with time of day, season, and magnetic activity. The statistics presented were based on over 1000 troughs and the features found were compared with previous work. (auth) (UK)

790 TRAVELING IONOSPHERIC DISTURBANCES OBSERVED THROUGH USE OF A THOMSON SCATTER TECHNIQUE EMPLOYING FARADAY ROTATION AT 140 MHz. Goodman, J. M. (Naval Research Lab., Washington, D. C.). J. Atmos. Terrest. Phys.; 33: No. 11, 1763-77(Nov 1971).

The Thomson scatter technique was combined with Faraday rotation in order to deduce electron densities over the Naval Research Laboratory's Randle Cliff Radar facility. The Randle Cliff Radar frequency of ~140 MHz was shown to be approximately ideal for use of this hybrid technique at midlatitudes. Electron density measurements made between ~180 and ~500 km during the daytime from November 1969 to May 1970 show both long (68 min) and short (20 min) period traveling ionospheric disturbances (TID); the average amplitude associated with the TID was found to be ~4%. It is suggested that the longer-period TID may be useful in deducing certain atmospheric parameters such as neutral scale height or temperature. (auth) (UK)

791 MERIDIONAL CURRENTS IN THE EQUATORIAL ELECTROJET REGION. Raja Rao, K. S. (Indian Inst. of Geomagnetism, Bombay); Joseph, K. T. J. Atmos. Terrest. Phys.; 33: No. 11, 1793-7(Nov 1971).

The equatorial electrojet model given by Untiedt conceives of a vertical current and therefore a meridional current. Computations are made of ΔX_m and ΔY_m, measures of electrojet currents flowing towards geomagnetic east and of meridional currents flowing towards geomagnetic north, using the mean hourly values of horizontal force and declination observed at Trivandrum, Kodaikanal, Annamalainagar, Alibag, and Huancayo. The meridional currents here computed flow from south to north across the dip equator and are different from the meridional currents in the Untiedt model which are not observable on ground. These currents do not form part of the Sq current system. They flow from south to north in the ionosphere and close circuit in the magnetosphere as was first suggested by Van Sabben [J. Atmosph. Terr. Phys., 28: 965(1966)]. The overhead meridional current intensity is of the order of 30 to 40 amp/km. The meridional electric field under the electrojet forms about 5 to 10% of the main east–west electric field. The comparison of the east force at Alibag with the stations under the electrojet reveals that the meridional currents under the electrojet are weaker than those outside it. (auth) (UK)

792 MAGNETOSPHERE. Siebert, M. (Univ., Goettingen, Ger.). pp 52-77 of Plenarvortraege. Stuttgart; B. G. Teubner (1969). (In German).

From thirty-fourth physicists conference; Salzburg, Austria (29 Sep 1969). See CONF-690975.

Discussed are concepts of the magnetosphere and its interaction with the solar plasma. Treated are the plasma density in the magnetosphere according to whistler data, relationship between solar wind and magnetosphere, and the time course of a magnetic storm and its interpretation. Some evidence seems to indicate that certain pulsations in the geomagnetic field, with oscillation periods in the second or minute range, result from oscillations in the magnetosphere. Increased recognition of such interrelationships will permit more reliable predictions about processes in the most extreme ranges of the atmosphere. Emphasized is the close cooperation between continuous measurements on the Earth's surface, satellite observations, and monitoring by rockets. (H.B.G.)

Low-Temperature Physics and Cryogenic Equipment

Superfluidity

793 POSSIBLE ORIGIN OF THE NEUTRAL CURRENT IN LIQUID HELIUM. Halley, J. Woods; Giese, C. (Univ. of Minnesota, Minneapolis). Phys. Lett.; 37A: No. 1, 59-60(25 Oct 1971).

The consequences of a model for the generation of the anomalous current seen by Surko and Reif in liquid helium are investigated. The model accounts qualitatively for the reported features of the experiment. (auth)

794 LIGHT SCATTERING BY SUPERFLUID HELIUM UNDER PRESSURE. Vinen, W. F. (Univ. of Birmingham, Eng.). J. Phys., C (London); 4: No. 14, L287-9(7 Oct 1971).

The theory of Brillouin scattering by superfluid helium is discussed, and the predicted scattering for helium under pressure is shown to differ significantly from that quoted recently by Ganguly [Phys. Rev. Lett., 26: 1623(1971)]. (auth)

Superconductivity

Refer also to abstract 411.

795 (AI-AEC-12818, pp 31-4) ELECTRONIC STRUCTURE OF METALS AND ALLOYS. Breckenridge, R. G.; Barnes, L. J.; Fink, H. J.; Wipf, S. L.; Nakata, M. (Atomics International, Canoga Park, Calif.). Jan–Mar 1969.

In AEC unclassified programs.

Progress is reported on tunneling at point contacts between superconductors, influence of a temperature difference across a point contact between superconductors, thermal diffusivity of superconductors, stability of the superheated Meissner state due to three-dimensional fluctuations of the order parameter and vector potential, and surface nucleation in a superconductor coated with a normal metal. (J.C.W.)

796 (AI-AEC-12860, pp 43-9) ELECTRONIC STRUCTURE OF METALS AND ALLOYS. Breckenridge, R. G.; Barnes, L. J.; Fink, H. J.; Wipf, S. L. (Atomics International, Canoga Park, Calif.). 1969.

In AEC unclassified programs.

The role that the electronic structure of metals and alloys plays in determining electrical, thermal, magnetic, vibrational, and alloying characteristics is investigated. The electron tunneling behavior that can occur at anodized point contacts between various superconducting metals and alloys was investigated. Most of the point contact junctions were initially (weakly) superconducting (small critical currents) probably due to microscopic metallic shorts (deduced from behavior in magnetic fields). Sustaining a voltage difference across a superconducting weak link is a convenient way to create a difference in thermodynamic free energy between two superconductors. A novel way to create a free energy difference between any two materials is by a temperature difference. Apparatus has been completed to sustain a temperature difference across a mechanically-controlled point contact between two superconductors. Various nucleation field calcula-

tions were made. Boundary value solutions of the nonlinear Ginzburg–Landau equations have been obtained on the analog computer for both cylindrical and infinite slab geometry. An experiment is being developed to measure the thermal diffusivity of selected superconductors below the critical temperature in a magnetic field. (J.C.W.)

797 (AI-AEC–12887, pp 27-32) ELECTRONIC STRUCTURE OF METALS AND ALLOYS. Breckenridge, R. G.; Barnes, L. J.; Fink, H. J.; Wipf, S. L.; Nakata, M. M. (Atomics International, Canoga Park, Calif.). Jul–Sep 1969.

In AEC unclassified programs.

Progress is reported on the role that the electronic structure of metals and alloys plays in determining electrical, thermal, magnetic, vibrational, and alloying characteristics. Technical progress includes data on stability limit of the superheated Meissner state due to three-dimensional fluctuations of the order parameter and vector potential, surface nucleation and boundary conditions in superconductors, superconducting surface sheet of a semi-infinite half space and its instability due to fluctuations, proximity effect of superconductors in high magnetic fields, measurement of thermodynamic properties with superconducting weak links, and thermal properties of superconductors. (J.C.W.)

798 SUPERCONDUCTING MATERIALS AND THEIR ENGINEERING APPLICATIONS. Catterall, J. A. (National Physical Lab., Teddington, Eng.). Contemp. Phys.; 12: No. 5, 495-514(Sep 1971).

A short account is given of the characteristic properties of superconductors and the reasons for the importance of superconductivity in science and technology. The occurrence of the phenomenon in metals, alloys, and chemical compounds is briefly discussed, with particular reference to those materials having the highest critical temperatures. The main emphasis is on the application of superconductivity in engineering, and attention is particularly devoted to materials for magnet construction, the various uses of superconducting magnets, and the other applications of superconductors, such as in power transmission cables, and transformers. Some forecasts are made regarding the probable developments in superconductivity in the next few years. (auth) (UK)

799 SOME SUPERCONDUCTING INTERCALATION COMPLEXES OF TaS_2 AND SUBSTITUTED PYRIDINES. Gamble, F. R. (Syva Research Inst., Palo Alto, Calif.); Osiecki, J. H.; DiSalvo, F. J. J. Chem. Phys.; 55: No. 7, 3525-30(1 Oct 1971).

Following the discovery of superconductivity in TaS_2 $(pyridine)_{\frac{1}{3}}$, a number of similar complexes using substituted pyridines were prepared in order to learn how the structure, stoichiometry, stability, and superconducting critical temperature of the complex are interrelated. In these complexes atomically thin, metallic layers of TaS_2 and layers of substituted pyridines alternate. X-ray diffraction studies and chemical analyses show that they are usually highly crystalline and stoichiometric. The critical temperature varies between 1.5 and 4.5°K and generally increases as the number of molecules per TaS_2 is increased. (auth)

800 ISOTOPE EFFECT IN SUPERCONDUCTORS UNDER PRESSURE. Tareeva, E. E.; Trapezina, T. I. (High Pressure Inst., Moscow). Phys. Lett.; 37A: No. 1, 83-4(25 Oct 1971).

The variation of the isotope effect in superconductors with pressure is calculated in the framework of well-known theories. This variation is found to be strong enough to present an experimental test of a theory. (auth)

801 ULTRASONIC ATTENUATION OF GAPLESS SUPERCONDUCTING FILMS. Kraetzig, E. (Philips Forschungslaboratorium GmbH, Hamburg). Phys. Lett.; 37A: No. 1, 21-2(25 Oct 1971).

The ultrasonic attenuation of superconducting Sn and Pb films in a parallel magnetic field was measured and compared to calculations for superconductors containing magnetic impurities according to the equivalence theorems of Maki and Fulde. (auth)

802 CALCULATION OF THE PERPENDICULAR CRITICAL MAGNETIC FIELD FOR SUPERCONDUCTING FILMS. Sommers, Hans-Juergen (Univ., Goettingen, Ger.). Z. Phys.; 247: No. 4, 365-79(1971). (In German).

On the basis of the BCS theory a simplified system of equations for the calculation of the perpendicular critical magnetic field, $H_{c\perp}$, for superconducting films is derived with the help of "the method of the correlation function," developed by Lüders. In the vicinity of $T = T_c$ for all film thicknesses and mean free paths the problem becomes mathematically equivalent to the calculation of the residual resistance of the film. The results are in good agreement with the experiments of Harper and Tinkham and of others. Further limiting cases are investigated: on the one hand specular reflection and weakly diffuse surface scattering, on the other hand diffuse reflection and very thin films. (auth)

803 OPERATION OF SUPERCONDUCTING FLUX PUMPS. Lihl, Franz; Weber, Rudolf (Institut fuer Angewandte Physik, Vienna. Siemens AG, Erlangen, Ger.). Z. Angew. Phys.; 31: No. 5-6, 250-8(1971). (In German).

The movement of a zone of normal conductivity, which includes magnetic flux, across a current-carrying superconducting plate affects the efficiency of a flux pump: characteristic voltages are created opposing the induced emf, which increase as the current increases. Here a flux pump is described, designed to measure the distribution of the magnetic field around the superconducting plate. The measurements show, that a large screening-current is established around the normal zone as the latter is moved across plates of niobium. Even after the zone has left the plate, the screening current still persists. This information now explains the observed voltages. However, the frozen-in flux also limits the current to be pumped by the flux pump. Furthermore, the distribution of this pumped current in the plate is such, that its magnetic fields weakens or strengthens the exciting magnet, depending upon the sense of rotation. (auth)

804 ONSET OF THE ODLRO IN SUPERCONDUCTING INTERCALATED LAYER COMPOUNDS. Tsuzuki, T.; Matsubara, T. (Institut Laue-Langevin, Garching, Ger.). Phys. Lett.; 37A: No. 1, 13-14(25 Oct 1971).

The correlation function of the superconducting order parameter above the transition point is discussed, based on an exactly solvable model. It is shown that the correlation behaves like that of two-dimensional systems in short range and like that of three-dimensional systems in long range. (auth)

805 CALIBRATION OF SUPERCONDUCTOR MAGNETIZATION DATA. Ward, D.; Sutton, J. (Central Electricity Research Labs., Leatherhead, Eng.). J. Phys., C (London); 4: No. 13, 1837-9(17 Sep 1971).

A method is described for obtaining initial slope values for magnetization curves of superconductors which is appreciably more accurate than that of relying on the first few low field points. (auth) (UK)

806 SUPERCONDUCTORS WITH MAGNETIC IMPURITIES IN A SINGLET GROUND STATE. Capellmann, H. (Univ. of Pennsylvania, Philadelphia). J. Phys. Chem. Solids; 32: No. 10, 2439-47(Oct 1971).

The effect of magnetic impurities (Pr and Tm) on the superconductors Th, $LaPb_3$ and $LaSn_3$ is discussed. Due to crystal field splitting the impurities have a nonmagnetic ground state and low lying excited states. In particular the case of Pr in $LaPb_3$ is discussed. Interband mixing of 4f and conduction electrons leads to a dynamical electron–electron interaction due to exchange of virtual excitations of the impurities. This leads to a lowering of the superconducting transition temperature T_c. (auth)

807 GINZBURG–LANDAU PARAMETER AND SURFACE SUPERCONDUCTIVITY IN Al THIN FILMS. Maloney, M. David; de la Cruz, Francisco (Brown Univ., Providence). Solid State Commun.; 9: No. 19, 1647-9(1 Oct 1971).

Measurements of $H_{||}(t)$ and $H_{\perp}(t)$ in Al films support the known disparity between bulk and thin film determination of κ. The thicker films measured exhibit surface superconductivity at low temperatures ($\kappa > 0.42$). (auth)

808 VANISHING OF SUPERCONDUCTIVITY BELOW A SECOND TRANSITION TEMPERATURE IN $(La_{1-x}Ce_x)Al_2$ ALLOYS DUE TO THE KONDO EFFECT. Riblet, G.; Winzer, K. (Univ., Cologne). Solid State Commun.; 9: No. 19, 1663-5 (1 Oct 1971).

A second transition back into the normal state at temperatures below the transition temperature T_c for certain $(La_{1-x}Ce_x)Al_2$ alloys was observed in agreement with the recent prediction by E. Mueller–Hartmann and J. Zittartz [Phys. Rev. Lett., 26: 428 (1971)] that such an effect could exist in a Kondo superconductor with $T_K \ll T_c$. (auth) (UK)

809 MODEL HAMILTONIAN IN THE THEORY OF SUPERCONDUCTIVITY. Bogolyubov, N. N. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 301-64 of Problemy Fiziki Elementarnykh Chastits i Atomnogo Yadra. Tom 1, Vypusk 2. /Bogolyubov, N. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

A system of fermions with attraction described by the model Hamiltonian of the theory of superconductivity with separable interaction is considered. Asymptotically exact estimations are obtained (as $V \to \infty$) for the minimal eigenvalue of the Hamiltonian, correlation functions, and Green's function. (auth)

Equipment and Devices

Refer also to abstracts 229 and 1107.

810 SELF REGULATING MINI-COOLER FOR THREE-DIMENSIONAL SINGLE-CRYSTAL NEUTRON DIFFRACTION MEASUREMENTS. Ebdon, F. R.; Wheeler, D. A. (Australian Inst. of Nuclear Science and Engineering, Sutherland). J. Appl. Crystallogr.; 4: 254-5(1971).

A device is described which may be used with a neutron diffractometer to obtain three-dimensional single-crystal data at temperatures between 77 and 290°K. (auth) (UK)

811 MINIMIZATION OF IMAGE EFFECT ERRORS IN MAGNETIZATION MEASUREMENTS WITH A SUPERCONDUCTING SOLENOID. Stevens, W. N. R. (Univ. of Manitoba, Winnipeg). J. Phys., E (London); 4: No. 11, 850-2(Nov 1971).

The problem is considered of image effect errors in inductive methods of magnetization measurement when a superconducting solenoid provides the magnetizing field. Apparatus design factors relevant to minimizing such errors are discussed in relation to other design considerations in terms of a simple model of specimen field distortion. The importance of obtaining the tightest possible coupling between specimen and detection coil, and the advantage of a large relative solenoid bore are pointed out. (auth) (UK)

812 INVESTIGATION OF IMAGE EFFECT ERROR IN AN APPARATUS FOR MAGNETIZATION MEASUREMENT USING A SUPERCONDUCTING SOLENOID. Stevens, W. N. R. (Univ. of Univ. of Manitoba, Winnipeg). J. Phys., E (London); 4: No. 11, 853-6(Nov 1971).

An investigation of image effect error in an apparatus for magnetization measurement in which a superconducting solenoid provides the magnetizing field was made by using a current carrying coil to simulate a magnetic specimen. The apparatus was designed to minimize the image effect error: free space specimen flux penetration into the volume occupied by superconductor would be 11%. An effect giving a 0.5% change of flux enclosed by the detection coil was found, but this was found to be independent of specimen moment and solenoid field to within the experimental precision of 0.05%. (auth) (UK)

813 EFFECT OF BIAS VOLTAGE ON THE FREQUENCY RESPONSE OF POINT-CONTACT JOSEPHSON RADIATION DETECTORS. Blaney, T. G. (National Physical Lab., Teddington, Eng.). Phys. Lett.; 37A: No. 1, 19-20(25 Oct 1971).

The variation with bias voltage of the video response of superconducting point contacts to high microwave frequencies was measured by Fourier transform spectroscopy. The signal polarity was observed to reverse at the Josephson frequency, confirming other recent results. (auth)

814 THERMAL RELEASE OF HYDROGEN ISOTOPES FROM CRYOGENIC SURFACES. Erents, K.; McCracken, G. M. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Vacuum; 21: No. 7, 257-60(Jul 1971).

Measurements were made of the release rate of hydrogen and deuterium from a cold surface during uniform heating from 2.5 to 6.5°K. A simple theory was formulated to account for the experimental results, which show good agreement with vapour-pressure measurements by Lee (1971). The results indicate binding energies higher than the thick-layer sublimation energy for coverages $\leq 10^{16}$ mole/cm^2. Extrapolation of hydrogen and deuterium data provided thermal release data for tritium. (auth) (UK)

Plasma and Thermonuclear Physics

815 PLASMA PHYSICS INDEX. VOLUME 6, NO. 8, 1971. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 152p.

This listing contains 450 articles on various aspects of plasma physics. (M.O.W.)

Confinement and Heating

Refer also to abstract 867.

816 (AEC-tr-7273) STUDIES OF DIFFUSION OF DENSE DECAYING PLASMA IN A STELLARATOR. Demirkhanov, R. A.; Baratov, G.; Malykh, N. I.; Merzhkin, V. G.; Stotland, M. A.; Ten, Yu.; Khil, Sh. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Sukhumi. Fiziko-Tekhnicheskii Institut). Translation of report NP-18502. 11p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 1163. (M.O.W.)

817 (IAE-2058) ROLE OF ION SOUND DURING ELECTRON CYCLOTRON HEATING. Ivanov, A. A. (Institut Atomnoi Energii, Moscow (USSR)). 1970. 55p. (In Russian). Dep. NTIS (U. S. Sales Only).

A study was made of the phenomenon of stochastic heating of plasma electrons in the presence of electron cyclotron heating. Cyclotron heating of electrons is studied in the quasi-linear approximation. The problem of stochastic heating is discussed in detail. It turns out that, as a result of decay into ion sound and a hybrid wave and their converse confluence, the initially monochromatic cyclotron wave is broadened to such an extent that the ordinary quasi-linear theory of waves with merged phases is applicable to them. The solution of the quasi-linear equation gives estimates of the limiting electron temperatures. The appearance of a group of hot electrons is explained, and it is demonstrated that all the particles drift into the loss cone with time. A detailed discussion is given of the problem of broadening of the initial monochromatic cyclotron wave as a result of its decay into ion sound and hybrid waves and their converse confluence. Estimates are obtained for the finite width of the wave packet and the packet formation time. An experiment in cyclotron heating of plasma electrons is described. The experimental results are in agreement with the theoretical conclusions. (auth)

818 (TID-25804) TRIP REPORT OF TRAVEL IN SOVIET UNION BY THREE-MAN TEAM OF SPECIALISTS ON TURBULENT HEATING, OCTOBER 10 TO NOVEMBER 1, 1970. Wharton, Charles B. (Cornell Univ., Ithaca, N. Y.); Robson, Anthony (Texas Univ., Austin); Alexeff, Igor (Oak Ridge National Lab., Tenn.). Sep 1971. 25p. Dep. NTIS.

819 EXPERIMENTAL RESULTS ON ELECTROSTATIC STOPPERING. Moir, Ralph W.; Barr, William L.; Post, Richard F. (Univ. of California, Livermore). Phys. Fluids; 14: No. 11, 2531-4(Nov 1971).

In a pulsed experiment a magnetically guided plasma stream is reflected by a double-electrode structure. Space-charge-limited densities up to 4×10^{11} cm^{-3} are calculated and verified. An application to stopper one end of a mirror fusion reactor is discussed. (auth)

820 MAGNETOHYDRODYNAMIC EQUILIBRIUM EQUATIONS FOR AN AXIALLY ASYMMETRIC FINITE β TOROIDAL PLASMA. Matsuura, Kenya (Electrotechnical Lab., Tokyo). J. Phys. Soc. Jap.; 31: No. 5, 1544-52(Nov 1971).

The well-known magnetohydrodynamic equilibrium equations are reduced to the equations of convenient forms for the purpose of an investigation for equilibria of axially asymmetric toroidal plasmas with diffuse boundaries by introducing two scalar functions corresponding to a stream function in an axially symmetric case. In the reductions, it is assumed that the toroidal effect is small; namely, the quantities of the configurations are expanded in a ratio of the minor radius to the major radius. Mainly, configurations of bumpy and helical types are considered. In the former case, the forms of the resultant solutions give a picture of the bumpy-type configuration which has helical character as the toroidal effect. The helical-type configuration has no longer completely helically symmetric structures because of its toroidal effect. (auth)

821 RESEARCH ON CONTROLLED THERMONUCLEAR FUSION. PLASMA HEATING. Consoli, T. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 157, 13-34(Mar 1971). (In French).

The heating of a plasma, confined in a toroidal configuration, up to temperatures at which the thermonuclear reactor can ignite, was studied. In a general and deliberately noncomprehensive survey, the various methods used are reviewed. A bibliography is included. This survey takes account of similar research conducted throughout the world in laboratories working on controlled fusion. (France)

Diagnostics

822 (SC-DC-714077) CONTINUUM THICK SHEATH PROBE STUDIES IN HYPERSONIC IONIZED BOUNDARY LAYERS. Touryan, K. (Sandia Labs., Albuquerque, N. Mex.); Boyer, D. W. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). [1971]. 24p. (CONF-710921-1). Dep. NTIS.

From International symposium on dynamics of ionized gases; Tokyo, Japan (13 Sep 1971).

Extensive studies were made of the sheath structure and current collection characteristics of flush-mounted electrostatic probes installed on the dielectric surface of a sharp-leading-edge flat

plate in an ionized hypersonic flow environment. The studies included experimental and numerical investigations of the effect of probe size, geometry, applied voltage, and local hypersonic boundary layer properties on the current–voltage characteristics of the probes. Test conditions were such that the sheath was collisional and often constituted an appreciable part of the boundary layer. (auth)

823 CONTINUOUS MEASUREMENT OF THE PLASMA ELECTRON DENSITY BY MEANS OF CAVITY RESONATORS. Janzen, Gerd (Univ., Stuttgart). Z. Angew. Phys.; 31: No. 5-6, 296-300(1971). (In German).

The determination of the plasma electron density by means of microwave cavity resonators usually is done in the way that, for every plasma state, the entire resonance curve has to be measured and evaluated. A digital control system is described with which the electron density can be measured directly as a function of a plasma parameter or as a function of time. The smallest detectable variation of density is in the order of 10^7 electrons/cm^3 for the most favorable resonance modes. The good time response allows direct measurements in the afterglow. Results taken in nitrogen, neon, and mercury plasmas are discussed. (auth)

824 SIGNAL DISPERSION AND FARADAY ROTATION IN HOT PLASMAS. Skilling, J. (Princeton Univ., N. J.). Phys. Fluids; 14: No. 11, 2523-31(Nov 1971).

The signal dispersion and Faraday rotation of high-frequency radiation passing through a hot, possibly relativistic plasma are investigated. Corrections are found to the formulas given by cold-plasma theory. Results for the damping are compared with synchrotron self-absorption formulas. (auth)

825 DIFFERENTIAL METHOD OF MEASURING PLASMA POTENTIAL. Hoffmann, C. R.; Lees, D. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 13: No. 8, 689-91(Aug 1971).

A double-probe system for determining plasma potential is described in which, in addition to the usual emitting probe, a cold probe is used to collect current from a nearby similar region of plasma. (UK)

826 COMMENTS ON "COMPARISON OF PROBE AND SPECTROSCOPIC MEASUREMENTS IN AN ARGON PLASMA JET." Clements, R. M.; Smy, P. R. (Victoria Univ., British Columbia). J. Phys., D (London); 4: No. 10, L37-8(Oct 1971).

The experimental results given in a recent paper by Holmes and Freeston (J. Phys. D, 4: 452(1971)) are found to be in good agreement with a theory due to Lam in 1964 (J. Amer. Inst. Aeronaut. Astronaut., 2: 256(1964)). Their poor agreement with the thin-sheath formula of Clements and Smy (J. Appl. Phys., 40: 4553 (1969) and 41: 3745(1970)) is also explained. (auth) (UK)

827 FLOW PROPERTIES OF A PARTIALLY IONIZED FREE JET EXPANSION. Fraser, R. B.; Robben, F.; Talbot, L. (Univ. of California, Berkeley). Phys. Fluids; 14: No. 11, 2317-27(Nov 1971).

Diagnostic studies were carried out in an induction-heated low-density supersonic plasma jet. The neutral number densities were obtained from the calibrated intensity of the 4609-Å argon II line excited by a 25-kV electron beam, and the velocities and heavy particle temperatures were determined by measuring the Doppler shift and Doppler broadening with a Fabry–Perot interferometer in two linearly independent directions, following a technique developed by Muntz. The contribution to the 4609-Å line due to the plasma self-emission was found to be negligible. The density, impact pressure, and velocity along the free jet center line all followed the isentropic source flow model up to the Mach disc. The temperature, however, showed an unexpected rise above the isentropic prediction. Ion number densities and electron temperatures were measured with a double Langmuir probe. The fraction of ionization was frozen at about 0.1% along the free jet axis. Calculations of the fraction of the energy of recombination absorbed by the electrons and the fraction lost by radiation from an electron energy balance showed good agreement with an a priori estimate based on collisional–radiative recombination. (auth)

828 EXPERIMENTAL INVESTIGATION OF THE 90 MW ROTATING MAGNETIC FIELD PINCH. Berney, A.; Heym, A.; Hofmann, F.; Jones, I. R. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Plasma Phys.; 13: No. 8, 611-36(Aug 1971).

The results and interpretation of measurements made on the 90-MW rotating magnetic field pinch are presented. Three standard filling pressures of 20, 60, and 180 mtorr He were chosen, and the following measurements were made: streak and framing photography, electron line-density profiles, electron and ion temperatures, and detailed magnetic probe measurements. (auth) (UK)

829 SPECTRAL CHARACTERISTICS OF AN OPTICALLY DENSE PLASMA. Preobrazhenskii, N. G.; Senina, A. V. (Siberian Physical-Technical Inst., Novosibirsk, USSR. Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 25-37(1971). (In Russian).

The most important qualities of spectroscopic methods of investigating plasmas include an almost ideally rapid response, the absence of extraneous interference, the comparative ease of the measuring operations, and most of all, an unusually large potential volume of information embodied in the recorded spectrum. This review gives a resume of recent performances of the progressive direction of the theory. One section is devoted to the radiative transfer equation, which is followed by the so-called "source function" based upon the phenomenological approach, whereby a function plays a decisive role in a given problem and is determined by a complex of interacting elemental processes. This source function is given a quantum treatment. Later a number of approximations are introduced, and the following basic generalizations are considered: the kinetics of excited atoms in a plasma layer with a partially reflecting surface, transfer of radiative transfer into lines superimposed on a strong background, radiative transfer allowing for diffusion of excited atoms, and nonlinear kinetics due to induced radiation. (K.S.W.)

830 RADIAL PARTICLE DISTRIBUTION PROFILE IN A LOW-TEMPERATURE GAS DISCHARGE PLASMA. Chiplonkar, V. T.; Joshi, S. B. (Inst. of Science, Bombay). Indian J. Pure Appl. Phys.; 6: No. 12, 649-50(Dec 1968).

It was shown that the departures, from the theoretical, of the observed radial distribution profiles of charge carriers, using the double probe method, could be accounted for in terms of volume recombination. From the observations, an estimate of the coefficient of volume recombination near the axis and near the wall was made for argon plasma (p = 400 microns; I_c = 4 mA.; and V_c = 520 V.). The estimated values are comparable to those reported in literature under similar conditions. (auth)

831 CULHAM'S LASER SCATTERING EQUIPMENT FOR THE TEXAS TOKAMAK. Forrest, M. J.; Peacock, N. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Atom (London); No. 180, 245-52(Oct 1971).

An optical system to enable measurements to be made of the plasma density and electron temperature of the Tokamak device at the University of Texas was designed and constructed at the Culham Laboratory. Using the technique of laser beam scattering, the system collects scattered light both in the forward direction and at right angles to the laser beam. An Ebert spectrograph with fiber optics coupling to gated photomultipliers is used to record the scattered spectrum, and axicone scanning optics enable information about the electron drift velocity and the strength and direction of the magnetic field to be obtained. (UK)

832 TIME-RESOLVED TEMPERATURE MEASUREMENTS OF A LASER-PRODUCED CARBON PLASMA. Puell, H.; Spengler, W.; Kaiser, W. (Technische Univ., Munich). Phys. Lett.; 37A: No. 1, 35-6(25 Oct 1971).

The rise and the decay of the plasma temperature was measured during individual laser pulses (approximately 20 nsec in duration). The experimental results agree quite well with theoretical predictions based on a stationary model. (auth)

833 EXPERIMENTAL MEASUREMENT OF THE EXCITATION TEMPERATURE OF A PLASMA TORCH JET. Kleimann, H.; Reynaud, R.; Pelourson, A. (Institut National des Sciences Appliques, Lyon). High Temp. - High Pressures; 2: No. 6, 617-30(1970). (In French).

Experimental determination of argon plasma jet temperature by the "norm temperature" method is described with brief details of the underlying theory, Pearce's numerical method, and the measurement technique employed. Although the method involves graphical determination of the temperature and assumes LTE, its accuracy is claimed to be adequate, while the procedure can be reduced to a simple routine. (auth) (UK)

Kinetics (General)

834 (NP-19064) DIVISION OF PLASMA PHYSICS AND FUSION RESEARCH PROGRESS REPORT, 1970. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Jul 1970. 48p. Dep. NTIS (U. S. Sales Only).

The lines of research at the Division are summarized, and obtained results and future plans are presented. The activities are mainly concentrated on basic plasma physics and its application to the thermonuclear fusion problem, but other fields are also involved in the research program, e.g., cosmic physics, special technical applications of plasmas, and the development of diagnostic methods and experimental devices. (auth) (Sweden)

835 STUDY OF A HIGH PRESSURE Ar PLASMA AS A RADIATION STANDARD. Goldbach, C.; Nollez; Peytureaux (Centre National de la Recherche Scientifique, Paris). Bull. Inform. Bur. Nat. Metrol.; 2: No. 5, 3-6(Jul 1971). (In French).

The Ar plasma studied was created in a high pressure stabilized electric arc of the Maeker type. The methods used for determining the temperature (T) are based on the local thermodynamic equilibrium assumption (LTE). The measured values of T do not differ by more than 5%, so a mean physical temperature of the plasma T can be defined. The luminance temperature of the plasma continuum was axially observed for a constant intensity of 100 A. It becomes almost constant and equal to 6,100°K for pressures above 50 bars. Therefore, under these experimental conditions, the plasma continuum radiates as a black body at 6,100°K, (T being 11,000°K). (France)

836 PERIODIC CURRENT AND RADIATION PULSING IN dc EXCITED XENON PLASMA. Chuang, Shih-shung; Gamo, Hideya (Univ. of California, Irvine). Appl. Phys. Lett.; 19: No. 5, 150-2(1 Sep 1971).

A periodic current pulse with pulse width around 1.5 μsec and peak current around 1 A is generated in the dc-excited pure xenon plasma when the capacitance between cathode and anode is increased. Each current pulse is accompanied by one or two superradiant radiation pulses of 3.5-μm wavelength with pulse width ranging from 0.3 to 1 μsec and peak power of about 1 mW. (auth)

837 CONTRIBUTION OF RADIATION TO THE MASS TRANSPORT IN THE FLOW OF A MONOATOMIC GAS. Ferrari, Carlo. Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.; 105: No.3, 383-90(May-Jun 1971). (In Italian).

The flow of a monoatomic gas in a radiation field is considered. The contribution of the radiation to the rate of variation of the density number of the atoms in any given energy state i (radiation source function) as a result of the radiant processes represented by $A_i + h\nu_{ji} \rightleftharpoons A_j$; $A_k + h\nu_{ik} = A_i$ is determined. (tr-auth)

838 POSSIBILITY OF USING GAS DISCHARGE PLASMA LOCATED IN AN ALTERNATING MAGNETIC FIELD AS A MODULATOR OF ELECTROMAGNETIC RADIATION. Kats, L. I.; Kireev, N. N. (Saratov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 94-9(1971). (In Russian).

On the basis of dispersion relationships connecting a complex refractive index of a two-dimensional electromagnetic wave, propagated in a gas-discharge plasma with an overlapping magnetic field, the conditions of resonance and signal cutoff were determined. The dependence of the refractive index and the absorption of the circularly polarized wave on the magnitude of the alternating magnetic field was studied. The possibility of observing modulated effects of the passing signal is demonstrated. (tr-auth)

839 POSTULATION OF THE ARC RESTRIKE MECHANISMS FOR EXPLODING WIRES AND TUBES. Cheng, Dah Yu; Loubsky, William J.; Fousekis, Vlasis E. (Univ. of Santa Clara, Calif.). Phys. Fluids; 14: No. 11, 2328-36(Nov 1971).

The many facets of exploding wire restrikes are studied. They are related to the cylindrical shock wave, which pumps down the density of the center region of a line energy source or around the surface of the heated wire continuously to a lower density. When the density of any region is pumped down to lower than Paschen's electric breakdown criteria, restrike occurs. The cylindrical shocks occurring in exploding wires are, in general, divided into two types. In the first type the shock is generated by the wire explosion and in the second type the shock is generated by the heat conduction of the wire to the surrounding gas. Application of this mechanism to exploding tubes will enable one to create arc channels in arbitrary gaseous atmospheres with controllable plasma density with the contamination excluded. Neutral-density shielded plasma experiments, therefore, can be conducted in a controllable environment. (auth)

840 EXPERIMENTAL STUDIES OF HELIUM LINE BROADENING IN PLASMA. I. HIGH ELECTRON DENSITIES. Jenkins, J. E.; Burgess, D. D. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 4: No. 10, 1353-63(Oct 1971).

Experimental profiles were obtained at electron densities of the order of 10^{16} cm^{-3} of the He II 3023-Å transition, of two isolated He I lines (λλ 3965 and 2945) and of the important He I λ4471 transition and nearby forbidden component. Comparison with theory shows good agreement for the He II and isolated He I lines, but the discrepancy in the profile of He I λ4471 near the 2^3p-4^3F forbidden component can only partly be accounted for by density inhomogeneities in the source. (auth) (UK)

841 EXPERIMENTAL STUDIES OF HELIUM LINE BROADENING IN PLASMA. II. LOW ELECTRON DENSITIES (LINES WITH FORBIDDEN COMPONENTS). Burgess, D. D.; Cairns, C. J. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 4: No. 10, 1364-76(Oct 1971).

The He I λ4471 2^3P-4^3D and λ4921 2^1P-4^1D lines and their associated 2^3P-4^3F and 2^1P-4^1F forbidden components were studied in a highly reproducible and homogeneous plasma produced in the afterglow of a Z-pinch discharge. Electron densities in the range $3 \times 10^{14} < n_e < 10^{15}$ cm^{-3} were determined with high accuracy by interferometric and spectroscopic means, and electron temperatures were estimated spectroscopically. Full experimental line profiles for both lines are compared with theory at two electron densities. An important discrepancy between theoretical and experimental values for the forbidden component intensities and shapes, previously reported briefly by the authors for one line and one density, is confirmed for both transitions. (auth)

Kinetics (Experimental)

842 (FRNC-TH-87) STATIC BEHAVIOR AND INSTABILITIES OF THE Cs PLASMAS PRODUCED BY CONTACT IONIZATION IN SEALED TUBES. Moreau, J. B. (Paris Univ., Orsay (France). Faculte des Sciences). 1970. 127p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The properties of the Cs plasmas produced in sealed tubes were studied. The plasma was analyzed from the characteristics giving the current through the tube as a function of the voltage applied between the electrodes and by use of Langmuir probes. In the last case, a very-short-pulse method intended to obtain the characteristics point by point was developed. A macroscopic theory was used to explain the properties of the instabilities arising under certain working conditions. The principal parameters considered were: magnetic field, pressure, ion temperature, and electron longitudinal velocity. The limits for these instabilities to exist were precisely determined. To obtain a quiescent plasma in a sealed tube in the presence of a magnetic field, the longitudinal velocity of the electrons must be zero and the vapor pressure must be greater than a limit in excess of a few 10^{-4} torr, under the experimental conditions envisaged. Several tubes have been developed. They are robust and their lifetime may reach several hundred hours. (France)

843 ORIGIN OF ACCELERATED ATOMS ACCOMPANYING A PLASMA CLUSTER. Kartashev, K. B.; Pistunovich, V. I.; Platonov, V. V.; Filimonova, E. A. At. Energ. (USSR); 31: No. 2, 165-6(Aug 1971). (In Russian).

Using a passive corpuscular diagnostic method the concentration of atoms in a hydrogen plasma cluster was determined, the velocity of which $\approx 1 \times 10^8$ cm/sec. Such a cluster at a distance of 180 cm from the beam had an ion density of about 4×10^{12} cm^{-3}, and an energy of about 160 joules. Experiments were conducted with the INES installation, using a 32 μf capacitor and an accelerating voltage of 20 kV with two beam models, differing in the distance from the center of the opening to the end of the central electrode (80 and 30 mm). The fast atom current was determined as a function of the residual gas pressure in the chamber for the two beam models without a guiding magnetic field. The behavior of the two beam models is discussed. (K.S.W.)

844 EXPERIMENTAL INVESTIGATION OF STOCHASTIC ACCELERATION OF IONS IN AN INTENSE PLASMA-BEAM DISCHARGE. Berezina, G. P.; Berezin, A. K.; Zeidlits, V. P. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 14: No. 2, 49-51(20 Jul 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 2, 77-80(20 Jul 1971).

It was shown earlier that in an intense plasma–beam discharge it is possible to distinguish between two regimes of excitation of low-frequency oscillations: the first regime (relatively low pressures) is characterized by excitation of ion acoustic oscillations, which go over in time (after 30 to 40 μsec) into oscillations pertaining to the second regime. The stochastic acceleration of ions in the excitation of lf oscillations in the second regime is studied. (M.O.W.)

845 ION DYNAMICS IN A HIGH-VOLTAGE θ PINCH. Dove, William F. (Univ. of Maryland, College Park). Phys. Fluids; 14: No. 11, 2359-67(Nov 1971).

The interaction of low-initial-β hydrogen and argon plasmas with a fast rising magnetic piston [$\dot{B}(0) = 1.4 \times 10^{10}$ G/sec] was studied in a θ-pinch geometry. Doppler-broadened and -shifted line emission of ions and fast charge-exchange neutrals is used to determine the plasma dynamics. High Mach number flow ($M_A \geq 6$), diffusion, and strong ion heating are observed. In addition, large Doppler-shifted intensities indicate that ion reflection from the magnetic piston occurs giving velocities up to twice the piston velocity. (auth)

846 STRUCTURE OF TURBULENCE IN THE ZETA PLASMA. Robinson, D. C. (United Kingdom Atomic Energy Authority, Abingdon, Eng.); Rusbridge, M. G. Phys. Fluids; 14: No. 11, 2499-2511(Nov 1971).

The structure of turbulent electric and magnetic field fluctuations is described, and the internal dynamics of the associated velocity fluctuations are compared with those of fluid turbulence. It is suggested that the plasma turbulence is qualitatively similar to fluid turbulence, but with the turbulent elements elongated along the mean magnetic field to form rolls. This suggests that an appropriate comparison might be with the hypothetical two-dimensional limit of fluid turbulence, in which energy is expected to be transferred toward long wavelengths rather than to short wavelengths as for isotropic turbulence. In the plasma case, the direction of energy flow is inferred to be toward short wavelengths, but the measured form of the triple correlation is close to that expected for two-dimensional turbulence; one cannot, therefore, make a clear choice between the two alternatives. Effects arising from the particle structure of the plasma do not appear to be important, except that at low pressures an increased damping occurs that may be ion Landau damping. The source of the turbulent energy is not primarily convection due to the pressure gradient, but involves some mechanism of direct coupling with the plasma current associated with the "excess resistance" of the discharge. (auth)

Kinetics (Theoretical)

847 (FRNC-TH-102) EFFECT OF THE ELECTRON CORRELATIONS ON STARK LINE BROADENING IN THE FRAMEWORK OF THE UNIFIED THEORY. Capes, Hubert (Paris Univ., Orsay (France). Faculte des Sciences). 1971. 50p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The behavior of an atom within a classical kinetic plasma is studied. Ion and electron effects are dealt with separately. The ions are responsible for the low-frequency part of the perturbing microfield which accounts for the atoms orientation and the sublevels created; this problem is treated statically. Electrons are responsible for the hf part of the microfield which produces the broadening and the shift in the initial line components. A hierarchy of coupled equation is derived from a distribution function which takes into account the internal variables of the atom and the dynamic variables of the plasma electrons. The closure assumption leads to a system of two integro-differential equations. These equations are solved and the collision operator, and the Stark profile of the line determined. The results confirm those previously obtained for the line center and are in agreement with the unified theory provided that the correlations are neglected. (France)

848 ENERGY TRANSFER TO IONS FROM AN UNNEUTRALIZED ELECTRON BEAM. Widner, M. M.; Guest, G. E.; Dory, R. A. (Oak Ridge National Lab., Tenn.). Phys. Fluids; 14: No. 11, 2547-8(Nov 1971).

Simulation studies of the response of an inhomogeneous plasma to an unneutralized electron beam have led to an analytic theory of the energy transfer from the beam to ambient ions. Energy is transferred to the plasma by the ion hybrid resonance and is retained because of phase mixing. (auth)

849 KINETIC THEORY OF A WEAKLY COUPLED AND WEAKLY INHOMOGENEOUS GAS. Oeien, Alf H.; Tjoetta, Jacqueline Naze (Univ., Bergen). Phys. Fluids; 14: No. 11, 2373-7(Nov 1971).

A study of the evolution toward equilibrium of a weakly coupled and weakly inhomogeneous one-component gas using the multiple-time-scale method is presented. The method is applied to the BBGKY equations and the first three hydrodynamic equations. For one special ordering between the inhomogeneity parameter and the parameter associated with the weak coupling, it is found that the equation for the temperature in the Burnett approximation must be supplemented with a dissipative term describing energy conversion from kinetic energy of particles to correlational electric field energy of the gas. (auth)

850 NONADIABATIC PARTICLE MOTION IN CUSPED MAGNETIC FIELDS. Howard, James E. (Princeton Univ., N. J.). Phys. Fluids; 14: No. 11, 2378-84(Nov 1971).

Analytic expressions are obtained for nonadiabatic jumps in the magnetic moment μ for particle orbits in linear and axisymmetric cusped magnetic fields, starting from an integral derived by Hastie and Taylor. The resulting formulas for $\Delta\mu/\mu$ are found to agree to within a few percent with values derived from computed orbits. In the limit of large mirror ratios, the theoretical results confirm a semi-empirical formula of Grad and van Norton. (auth)

851 CALCULATION OF ANOMALOUS RESISTANCE. Hamasaki, S.; Davidson, R. C.; Krall, N. A. (Univ. of Maryland, College Park). Phys. Fluids; 14: No. 11, 2385-7(Nov 1971).

The time development of a one-dimensional electron–positron plasma subjected to a weak applied electric field, E_0 = const, is calculated through the quasi-linear equations. The results are in good qualitative agreement with the computer simulation experiments of Boris et al. (auth)

852 INSTANTANEOUS WAVE EMISSION MODEL. Kruer, W. L. (Princeton Univ., N. J.). Phys. Fluids; 14: No. 11, 2397-2409(Nov 1971).

A useful treatment of electrostatic wave emission by fast particles in a plasma is given. First, the potential due to a fast particle is expressed as a simple integration over the particle orbit; several interesting results readily follow. The potential in the wake of an accelerating particle is shown to be essentially that produced through local excitation of the plasma by the particle freely streaming about its instantaneous orbit. Application is made to one dimension, and it is shown that the wave emission and absorption synchronize to the instantaneous velocity distribution function. Guided by these calculations, a test particle model for computing the instantaneous wave emission by fast particles in a Vlasov plasma is then formulated. This model lends itself to physical interpretation and provides a direct approach to many problems. By adopting a Fokker–Planck description for the particle dynamics, the broadening of the wave–particle resonance due to velocity diffusion and drag is calculated. This calculation readily yields the synchronization of the wave emission to the instantaneous velocity distribution, and also shows that some important nonanalytic dependences, due to velocity diffusion and drag, are retained. Finally, the emission model is used to treat electrostatic wave scattering by fast particles. It is shown that nearly resonant particles give an enhanced scattering of the waves. The maximum enhancement is derived and physically explained, in both quasi-linear and strong-trapping limits. (auth)

853 THEORY OF BEAM–PLASMA INTERACTION. Kadomtsev, B. B.; Pogutse, O. P. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Fluids; 14: No. 11, 2470-5(Nov 1971).

A new approach to the theoretical treatment of the cooperative phenomena at a beam–plasma interaction is proposed. It takes into account the bunching effect related to trapping of the beam electrons in waves. (auth)

854 MECHANISM OF ACCELERATION OF IONS ON THE FRONT OF IONIZATION OF A GAS BY A RELATIVISTIC ELECTRON BEAM. Rosinskii, S. E.; Rukhadze, A. A.; Rukhlin, V. G. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 14: No. 1, 34-7(5 Jul 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 1, 53-7(5 Jul 1971).

A mechanism is proposed for acceleration of the ions on the front of the ionization of a gas in the presence of a strong external longitudinal magnetic field greatly exceeding the magnetic field of the beam current and for arbitrary relativism of the electrons. The conditions are stated under which the ionization front can be regarded as a plane, and the return current in the plasma cancels the magnetic field of the beam current. It follows from these conditions that the total current in the beam should be larger than the vacuum limiting current. On the other hand, it is obvious that it should be smaller than the critical current in the compensated beam, for otherwise, as a result of the development of the electrostatic instabilities, the beam becomes locked in the plasma. The proposed mechanism of ion acceleration is effective if the critical current in the compensated beam, for a given geometry of the system, greatly exceeds the limiting vacuum current. Acceptable ratios of the critical current to the limiting vacuum current are given for relativistic and nonrelativistic beams. (J.C.W.)

855 FIRST-ORDER RELATIVISTIC KINETIC EQUATION FOR A TWO-COMPONENT INHOMOGENEOUS PLASMA. Wisnivesky, D.; Lerner, A. M. (Univ. National, La Plata). Rev. Mex. Fis.; 20: No. 2, 75-89(1971).

The dynamical evolution of a two-component slightly relativistic plasma ($T \approx 10$ KeV) is discussed by following Bogolyubov's method to solve Trubnikov's hierarchy of equations. The hierarchy is decoupled by means of the perturbation technique for a weakly interacting gas and solved up to second order. The final kinetic equation corresponds to the first-order relativistic correction to the Fokker–Planck equation for an inhomogeneous two-component plasma. The model is particularly adequate to discuss the transport properties of a fusion plasma. (auth)

856 RADIATION PROBLEMS IN THE PRESENCE OF AN ANISOTROPIC HOMOGENEOUS PLASMA SLAB. Zich, R.

Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.; 105: No.3, 337-54(May-Jun 1971).

Radiation from a point or line source in a stratified system including an anisotropic plasma slab is considered. Starting from the Bresler–Marcuvitz formalism, the transverse field is evaluated via a Fourier integral representation. Formal line equivalent network is introduced in discussing the produced field. (auth)

857 HYDRODYNAMIC EQUATIONS FOR ANISOTROPIC PLASMAS IN MAGNETIC FIELDS. II. TRANSPORT EQUATIONS INCLUDING COLLISIONS. Chodura, R.; Pohl, F. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Plasma Phys.; 13: No. 8, 645-58(Aug 1971).

Using a generalized expansion in Hermite polynomials for the distribution functions of plasma constituents collision integrals for electrical conductivity, viscosity, and heat conductances of parallel and perpendicular thermal energy are calculated. Explicit results for the coefficients of ion viscosity and heat conductivity of electrons and ions are derived. (auth) (UK)

858 ELECTRON ENERGY EQUATION FOR AN ATOMIC RADIATING PLASMA. Murty, S. S. R. (Indian Inst. of Science, Bangalore). J. Quant. Spectrosc. Radiative Transfer; 11: No. 11, 1681-1690(Nov 1971).

The electron-energy equation for an atomic radiating plasma is considered. Using the atomic model of Bates, Kingston and McWhirter (Proc. Roy. Soc., A267; 267 (1962); A270; 155 (1962)), the radiation loss-term valid for all optical thicknesses is obtained. A study of the energy gained by electrons in inelastic collisions shows that the radiation loss term can be neglected only for rapidly decaying or fast-growing plasmas. Emission from optically thin plasmas is considered next and an exact expression is given for the total radiation loss in a recombination continuum. A derivation of the Kramers–Unsöld approximation is presented and the error involved in estimating the total emitted recombination radiation by this approximation is shown to be small. (auth) (UK)

859 RADIATION FROM THETA PINCH WITH OSCILLATORY DENSITY. Green, T. S. (European Space Research Inst., Rome). J. Quant. Spectrosc. Radiative Transfer; 11: No. 11, 1691-8(Nov 1971).

Studies of radiation from theta pinches have provided a powerful method for investigation of excitation rates of ionic levels, and for identification of spectral lines observed in solar spectra. Some difficulties arise in interpretation due to uncertainties in the population and depopulation mechanisms particularly in the competition between radiative decay and collisional depopulation. The possibility that oscillation of the electron density in the pinch discharge produces an oscillation in line intensities that can facilitate the interpretation of the observations is considered. It is found that the amplitude of the oscillation of the line intensity, relative to its unperturbed value, depends sensitively on the excitation mechanism and the depopulation mode. In simple cases lines arising from cascade depopulation of one parent line can therefore be identified. In other cases, it may be possible to differentiate between the possible modes of depopulation of a level. (auth) (UK)

860 REDUCED LIMITS ON MAGNITUDE OF POSSIBLE PLASMA POLARIZATION SHIFTS. Burgess, D. D.; Peacock, N. J. (Imperial Coll. of Science and Technology, London). J. Phys., B (London); 4: No. 10, L94-7(Oct 1971).

Previous observations of broadened lines in high-density laser-generated plasmas set limits on plasma polarization shifts at least one order of magnitude smaller than current theoretical predictions. A correction of the theory is suggested which would remove this discrepancy. (auth) (UK)

861 IMPLOSION OF PLASMA IN THE THETA PINCH PHENOMENA. Miyamoto Tetsu (Nihon Univ., Tokyo). J. Phys. Soc. Jap.; 31: No. 5, 1553-9(Nov 1971).

The implosion of a plasma in the theta pinch is studied by the modified snowplow equations, where finite thickness of the imploding plasma layer is taken into consideration. They are derived from the magnetohydrodynamic equations for the extreme case in which the conductivity of the initial plasma is infinite and are solved under the thin-layer approximation. When the conductivity of the initial plasma is zero, they can be applied also if the shock front is infinitesimally thin. They reduce to the usual snowplow equation in the limit of zero thickness. It is shown that the layer position, predicted by the usual snowplow model, is between the average radius and the outer radius of the layer. The modified snowplow equations account for the exchange of the supplied energy for the kinetic and internal energy, as well as motions of the imploding layer. In the thin-layer limit, the total energy is equally distributed among the kinetic and internal energies. (auth)

862 PLASMA PHYSICS AND NUCLEAR FUSION. Williams, M. M. R. (Queen Mary Coll., London). J. Inst. Nucl. Eng.; 12: No. 5, 131-3(Sep-Oct 1971).

A report on the UKAEA Culham Laboratory Plasma Physics Summer School, July 1971 is given. The purpose was to provide an introduction to theoretical and experimental plasma physics, and the topics included waves in magnetised plasmas, plasma confinement and instabilities, plasma diagnostics, nonlinear effects, applications of plasma physics (including nuclear fusion), and astro- and geophysical problems. (UK)

863 APPLICABILITY OF QUASI-LINEAR THEORY FOR DYNAMICAL PLASMAS. Bloomberg, H. W. (Coll. of William and Mary, Williamsburg, Va.). Phys. Lett.; 37A: No. 1, 53-4 (25 Oct 1971).

Validity of quasi-linear theory as an initial-value problem is shown to depend on sufficient localization of the disturbance, which condition prevents saturation due to trapped-particle effects. (auth)

864 SELF-CONSISTENT THEORY OF POPULATION, IONIZATION, AND ELECTRON DISTRIBUTION. Suckewer, S. (Inst. of Nuclear Research, Warsaw). Z. Phys.; 247: No. 4, 354-64(1971).

Analytical formulas are derived for population of excited levels and degree of ionization of atoms not necessarily restricted to the Maxwellian distribution of the free electrons. The results are obtained by solving Boltzmann's equation with a simplified form of the inelastic collision term. Good agreement with numerical results of other authors is obtained. (auth)

Production

865 (IPP–1/120) PLASMA GENERATION BY AXIAL AND RADIAL IRRADIATION OF MICROWAVES IN THE PRESSURE RANGE BETWEEN 0,1 TO 10 mTORR H_2. Unsoeld, E. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Aug 1971. 58p. (In German). Dep. NTIS (U. S. Sales Only).

Investigations on hydrogen plasmas produced by means of linear polarized microwaves (f = 2.45 Gc, P_0 = 2.2 to 5.0 kW) are described. A superimposed homogeneous and stationary magnetic field $\vec{B}_z$ is tuned mainly to electron cyclotron resonance. The rf is coupled to the plasma by different antennas. For end-on irradiation (wave vector $\vec{k} \parallel \vec{B}_z$) a conical horn is used. With respect to toroidal discharge geometries also the side-on irradiation ($\vec{k} \perp \vec{B}_z$) is investigated. For this purpose two new T-shaped antennas are developed. In the pressure range investigated the plasma fills up the whole discharge tube (l = 200 cm, v = 10^4 cm^3). The electron densities are in the range between 2.5×10^{10} and 1.5×10^{11} cm^{-3}, the electron temperatures between 1,2 and 5,0 eV. The plasma produced by side-on rf irradiation ($\vec{k} \perp B_z$, $\vec{E} \parallel \vec{B}_z$) is used as a pre-ionization plasma for a following z-pinch discharge. The degree of ionization obtained in this way is $\gtrsim$5%. From density measurements at higher cyclotron harmonics, the optimal conditions for this type of pre-ionization are evaluated. (auth)

866 (LGI–70/12/E) REVIEW ON LASER-PRODUCED PLASMAS. Caruso, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati). Sep 1970. 23p. (CONF-700817–26). Dep. NTIS (U. S. Sales Only).

From fourth European conference on controlled fusion and plasma physics; Rome, Italy (31 Aug 1970).

A review is presented of experiments aimed at plasma production using lasers. The review considers different targets and different laser pulses. (M.O.W.)

867 (NP–19055) LASER PLASMA INJECTION INTO A STELLARATOR. Preprint No. 106. Andryukhina, E. D.; Blanken, R.; Voronov, G. O.; Donokaya, N. P.; Rabinovich, M. S.; Smirnova, A. D.; Fedyanin, O. I.; Khol'nov, Yu. V.; Shpigel, I. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1971. 11p. (In Russian and English). Dep. NTIS (U. S. Sales Only).

A plasma was produced by laser beam irradiation of a lithium target inside the TOR-1 stellarator. The dependence of the density, electron temperature, potential of the trapped plasma and pressure on the laser energy, size of the focal spot, position of the target, and strength of the magnetic field were studied. (M.O.W.)

868 MICROWAVE FREQUENCY CAVITIES (2450 MHz) IN PLASMA PRODUCTION. CAVITY II. Vidal, Bernard; Dupret, Christian; Goudmand, Pierre (Univ., Lille). J. Chim. Phys.; 68: No. 7, 1213-15(Jul 1971). (In French).

A microwave cavity (cavity II) intended for plasma production, operating at 2450 MHz, was tested in N_2, Ar, and H_2 at pressures from 3×10^{-5} mm Hg to two atmospheres. The cavity induces molecular dissociation and a high degree of excitation. (France)

869 PLASMA OF A LIGHT SPARK IN A GAS CLOUD. DIRECTED EJECTION OF A PLASMA AND ACCELERATION OF A FIREBALL OF A LIGHT SPARK. Askar'yan, G. A.; Tarasova, N. M. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 14: No. 2, 58-60(20 Jul 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 2, 89-93(20 Jul 1971).

A light spark was obtained in a small cloud of gas ejected by a high-speed valve to a vacuum chamber. The features of the spark were studied as functions of the gas pressure gradient, and also the concentration, amount, and velocity of the plasma directionally ejected from the region of the light spark because of the asymmetry of the gasdynamic expansion and the gradient of the magnetic field. The possibility of using such an optical-plasma gun to fill traps is discussed. (M.O.W.)

870 INITIAL IONIZATION IN A HELIUM SHOCK WAVE. Kalra, S. P.; Measures, R. M. (Univ. of Toronto). Phys. Fluids; 14: No. 11, 2544-7(Nov 1971).

A comparison is made between the theoretical two-step collisional ionization model and the observed profile for a helium shock wave using a laser Fabry–Perot interferometer. (auth)

871 FLAME PROPAGATION AND OVERDENSE HEATING IN A LASER CREATED PLASMA. Bobin, J. L. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Phys. Fluids; 14: No. 11, 2341-54(Nov 1971).

A one-dimensional continuum hydrodynamic theory is used to investigate the structure of the deflagration wave which occurs when a laser light beam impinges on a solid target. It is shown that the nonlinear electron heat conduction is responsible for most of the structure; a region of density higher than the cutoff is strongly heated. Density and temperature profiles are calculated. An approximate solution for the thickness x of the overdense layer gives $x = \frac{4}{5}[(\gamma-1)/(5\gamma-1)](m/k)^{\frac{1}{2}}A(T_c^2/\rho_c)$ (m is the ion mass, k is the Boltzmann constant, $AT^{\frac{5}{2}}$ is the nonlinear electron heat conduction coefficient, T_c is the temperature of the plasma at cutoff density ρ_c). The average density in the layer is about twice the cutoff density. The effects of viscosity and (since electrons are heated by the laser light) of ion–electron relaxation are evaluated. (auth)

Stability

872 (FRNC-TH-73) STUDY OF COLLISIONAL DRIFT AND RESISTIVE GRAVITATIONAL INSTABILITIES IN A DIFFUSION COLUMN. Touzeau, Michel (Paris Univ., Orsay (France). Faculte des Sciences). [nd]. 89p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

In confinement experiments, resistive drift instabilities related to a density gradient and resistive gravitational instabilities related to a magnetic field gradient can occur. The characteristics of the fluctuations occurring when the two sources of instability occur simultaneously were studied. A system was used allowing a change from a uniform field configuration to one in which the curvature of the magnetic field force lines could be varied. It is experimentally impossible to separate the two types of instability, although it is possible to pass continuously from a situation in which density-gradient effects dominate to a situation in which the curvature of the fields lines are more important. The experimental results are compared with theoretical predictions. (France)

873 (FRNC-TH-108) INSTABILITY IN TEMPERATURE ANISOTROPY OF A COLLISIONLESS PLASMA. LINEAR DESCRIPTION AND QUASILINEAR EVOLUTION. Montes Lozano, Carlos (Paris Univ., Orsay (France). Faculte des Sciences). [1970]. 101p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Instability in temperature anisotropy was studied in the case of a plasma in which this instability is assumed to be determined only by the electron space charge. The plasma is assumed to be collisionless and not submitted to an external magnetic field, which results in high temperatures and low densities. Certain anisotropic plasmas met in astrophysics correspond to the conditions specified (e.g., the solar wind remote from the Sun). The various unstable modes of this type of plasma were studied in detail, taking into account the ion dynamics. Relaxation in the temperature anisotropy by quasi-linear coupling of the particles with the unstable modes was also studied. (France)

874 (NP-19065) EXAMPLE OF THE MAGNETIC LINE-TYING EFFECT ON THE FLUTE INSTABILITY. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). May 1970. 9p. Dep. NTIS (U. S. Sales Only).

The magnetic line-tying effects on the flute-type instability are studied in a simple special case where the plasma is supported against gravity by a horizontal magnetic field and is bounded in the field direction by two vertical metal plates of finite electric conductivity. The growth rate of the instability is found to be strongly reduced by the plates, even at moderately high conductivities. (auth) (Sweden)

875 (UR-3942-10) NONLINEAR THEORY OF THE MIRROR FLUTE INSTABILITY. Simon, A.; Weng, C. I. (Rochester Univ., N. Y.). [1970]. Contract AT(30-1)-3942. 5p. (CONF-711016-2). Dep. NTIS.

From Conference on plasma theory; Kiev, USSR (19 Oct 1971).

The method of small amplitude nonlinear threshold analysis was used to study this instability. If one uses a set of equations with constant gravity, the nonlinear analysis predicts small amplitude saturation and nonexplosive behavior. However, if one allows for nonconstant gravity, one finds that a higher frequency mode which is introduced no longer saturates and produces explosive behavior. (M.O.W.)

876 (UR-3942-11) [NONLINEAR BEHAVIOR OF UNSTABLE PLASMA IN THRESHOLD REGIME]. Annual Progress Report. Simon, Albert [Rochester Univ., N. Y.]. 15 Sep 1971. Contract AT(30-1)-3942. 6p. Dep. NTIS.

Research progress on flute instabilities in fully ionized, collisionless, low density plasmas in simple mirror machines is reported. Drift instabilities in a collisional fully ionized plasma in a Q device are also studied. A summary of each study is given. (M.O.W.)

877 FEEDBACK STABILIZATION OF DRIFT-CYCLOTRON INSTABILITY. Kitao, Kazuo (Niigata Univ., Japan). Plasma Phys.; 13: No. 8, 667-79(Aug 1971).

It is theoretically predicted that drift-cyclotron instabilities driven by density gradient are feedback stabilized by modulated electron sources immersed within the plasma. The feedback source term included in the Vlasov equation is simply approximated by a distributed source. The fluid-like unstable modes with and without finite k_y, and the unstable modes due to the resonance between the ions and the perturbations with finite k_x are found to be suppressed simultaneously by negative feedback with gain in certain ranges, where k_z is the component of the wave vector along the magnetic field. It is also shown that the stable modes without feedback remain stable by negative feedback, and are destabilized or remain stable by positive feedback. (auth) (UK)

878 EXPERIMENTAL INVESTIGATION OF THE NONLINEAR STAGES OF DEVELOPMENT OF ION-ACOUSTIC INSTABILITY IN A PLASMA-BEAM DISCHARGE. Berezina, G. P.; Berezin, A. K.; Zeidlits, V. P. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 14: No. 1, 8-11 (5 Jul 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 1, 13-17(5 Jul 1971).

An investigation was made of lf oscillations excited upon interaction of an electron beam with a highly ionized plasma to study the nonlinear stages of development of the ion-acoustic instability. The shape of these oscillations was investigated with probes and photographs, and two excitation regimes of the lf oscillations could be distinguished. In the first regime (pressure 2.4×10^{-4} torr) the start of the current pulse is characterized by excitation of lf oscillations that have a relaxation character and go over in time, after 30 to 40 μsec, into oscillations pertaining to the second regime. The latter includes also oscillations generated during the entire duration of the current pulse at a gas pressure in the system above 6×10^{-4} torr, in view of the fact that the first regime terminates for these oscillations after several microseconds. Only the results for oscillations pertaining to the first regime are presented here; it is shown that this regime is characterized by excitation of nonlinear ion-acoustic oscillations. (J.C.W.)

879 DRIFT INSTABILITY IN COLLISIONLESS ALKALI METAL PLASMAS. Politzer, Peter A. (Princeton Univ., N. J.). Phys. Fluids; 14: No. 11, 2410-25(Nov 1971).

Measurements of low-frequency ($\omega \ll \Omega_i$) oscillations in collisionless, low-β, alkali-metal Q-device plasmas are reported. These oscillations are conclusively identified as density-gradient-driven drift waves by the agreement between experiment and the predictions of the linear theory with regard to frequency, wavenumber, and stabilization by ion Landau damping. The linear theory of collisionless drift waves is modified to take into account effects of cylindrical geometry. Also considered are radial gradients in the zero-order diamagnetic drift and plasma-rotation frequencies. The enhancement of resonant particle effects by the finite length of the plasma column is computed. The occurrence of discrete radial eigenfunctions is found to depend on the radial variation of the equilibrium plasma potential. The observed de-

pendence of amplitude on γ agrees with that predicted by the theory. The experimental results demonstrate the importance of centrifugal and Coriolis force effects in determining the oscillation frequency. Finally, the transition between collisionless and collision dominated drift waves is explored, and the relationship between the observed amplitudes and the predictions of several nonlinear theories is examined. (auth)

880 NONLINEAR THEORY OF THE CROSS-FIELD INSTABILITY: EXPLOSIVE MODE COUPLING. Sato, Tetsuya (Kyoto Univ.). Phys. Fluids; 14: No. 11, 2426-35(Nov 1971).

Nonlinear evolution of low-frequency drift waves in weakly ionized plasmas is investigated, including the quasi-linear and mode-coupling effects. An equation governing the development of these waves is presented in terms of an external parameter (electric field) under appropriate assumptions. The equation states that the plasma system experiences two types of transition when one increases the external parameter from zero to infinity. Below a certain value of the parameter any perturbations are stabilized, but at the critical point the system makes a soft-type transition and an unstable drift mode is excited which finally reaches a finite amplitude. When the parameter is increased beyond the critical point, the system sees another transition point beyond which the unstable mode can no longer remain a finite amplitude but diverges within a finite time; this implies an explosive instability. This explosive transition is caused by the mode-coupling process, which acts to destabilize the initially unstable (linear) mode. It is inferred thereby that, in the real plasma, a strong turbulence is realized in which a number of modes are strongly excited and interact with each other. (auth)

881 ELECTRON CYCLOTRON ELECTROMAGNETIC INSTABILITIES IN WEAKLY RELATIVISTIC PLASMAS. Jacquinot, J.; Leloup, C. (CEN, Fontenay-aux-Roses, France). Phys. Fluids; 14: No. 11, 2440-6(Nov 1971).

The relativistic dispersion relation of whistlers is solved for weakly relativistic plasmas. The solution takes into account various deviations from a Maxwellian distribution found in laboratory plasmas, namely: pressure anisotropy, loss cone, and cold plasma. The relativistic effects are shown to be strongly stabilizing, even for low-temperature plasmas, when the density is such that $\omega_p^2/\omega_c^2 \ll 0.25$. The spectrum of unstable waves is also shifted toward smaller frequencies. (auth)

882 EXPERIMENTAL OBSERVATIONS OF HALF-HARMONIC INSTABILITIES IN HOT-ELECTRON PLASMAS. Wagner, C. E.; Lidsky, L. M.; Blanken, R. A. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids; 14: No. 11, 2447-53(Nov 1971).

The fluctuation spectrum of a two-component, hot electron plasma generated by a beam–plasma interaction in a magnetic mirror was investigated. The unstable waves were studied with specially constructed high-frequency, impedance-matched probes. Correlation studies show that the wave numbers of the unstable modes satisfy $k_\perp a_e \sim k_\parallel a_e \sim 1$. The observed unstable frequencies ($\omega \sim 0.7\ \omega_{ce}$) and wave numbers are in good agreement with those predicted by half-harmonic electrostatic instability in a two-component electron plasma driven by the temperature anisotropy of the hot component. (auth)

883 STABILITY OF THE STRAIGHT l = 1 SCYLLAC CONFIGURATION. Freidberg, J. P. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids; 14: No. 11, 2454-61(Nov 1971).

A theory is presented for the stability of the m = 1 mode in the high β, l = 1 scyllac configuration. The results agree with each of the two fundamental theories previously derived in the appropriate limits and significantly extend the range of parameters over which the theory applies. (auth)

884 EXPERIMENTAL TEST OF THE QUASILINEAR THEORY OF THE GENTLE BUMP INSTABILITY. Roberson, C.; Gentle, K. W. (Univ. of Texas, Austin). Phys. Fluids; 14: No. 11, 2462-9(Nov 1971).

The nonlinear evolution of the instability resulting from a gentle bump on the tail of the electron velocity distribution of a plasma was investigated experimentally. An electron beam with a large velocity spread was injected along the axis of a collisionless plasma column immersed in a strong magnetic field. The equilibrium wave amplitude, spectral shape, and electron velocity distribution were measured and found to be in good agreement with the predictions of quasi-linear theory, providing the beam met the requirements of the theory. When the beam was too strong to be a gentle bump, deviations from quasi-linear theory appeared. (auth)

885 THRESHOLD ELECTRIC FIELD FOR EXCITATION OF PARAMETRIC INSTABILITIES IN INHOMOGENEOUS PLASMAS. Eubank, H. P. (Princeton Univ., N. J.). Phys. Fluids; 14: No. 11, 2551-2(Nov 1971).

Experimental observation of the threshold power required for excitation of the parametric instability is found to be in reasonably good agreement with the theory for inhomogeneous plasmas, and exceeds the threshold for a uniform plasma by an order of magnitude. (auth)

886 IONIZATION INSTABILITY IN THE PROPAGATION OF HIGH-CURRENT RELATIVISTIC ELECTRON BEAMS IN GASES. Andrews, M. L.; Davitian, H.; Fleischmann, H. H.; Nation, J. A. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 14: No. 11, 2553-5(Nov 1971).

Measurements of electron beams propagating in a gas-filled drift tube show pressure-dependent longitudinally periodic variations of light intensity, μ-wave emission, beam head velocity, and net current, which are consistent with an ionization instability. (auth)

887 ROUTH FUNCTION OF THIN PLASMA FILAMENTS. Nikulin, M. G. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 27-33(Mar-Apr 1969). (In Russian).

One of the possible methods of investigation of the stability of a plasma conductor with current, located in an external magnetic field, consists of the fact that such a conductor is considered as an electromechanical system with an infinite number of degrees of freedom. If it is possible to find in clear form a Lagrangian function describing the movement of the conductor near the position of equilibrium, then the stability can be investigated by known methods. In particular, for thin plasma filaments, which test long-wave perturbations of spiral or constricted type, it is possible to find a Lagrangian function by the very general assumption of relatively geometric fields. This makes it possible to study the stability in relation to the most dangerous, from the MHD point of view, of perturbations in series of apparatus with complex magnetic fields, where the plasma has the form of thin linear or closed filaments. Here, the method is generalized for the case of magnetic fields of arbitrary geometry. In Part 1 the theorem is presented according to which an ideal electromechanical system with closed currents in the quasi-steady-state approach is described by the Routh function, presenting the difference of mechanical Lagrange systems and the magnetic energy of currents in their own magnetic fields. In relation to mechanical variables this function plays the role of the usual Lagrangian function. In Part 2 the expression for the inherent magnetic energy of a thin closed plasma conductor, which tests smooth long-wave perturbations of spiral or constricted type, is presented in general form. (tr-auth)

Thermonuclear Processes

Refer also to abstract 1199.

888 (AEC-tr-7276) ELECTRIC FIELD IN TOROIDAL METALLIC CHAMBER WITH SECTIONS. Stotland, M. A.; Khil, Sh. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Sukhumi. Fiziko-Tekhnicheskii Institut). Translation of report NP-18505. 19p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 1236. (M.O.W.)

889 (CONF-710301-(Vol.2), pp 514-20) NEUTRON CROSS-SECTION REQUIREMENTS FOR FUSION REACTOR DESIGN. Steiner, Don (Oak Ridge National Lab., Tenn.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The nuclear-engineering design of a fusion reactor involves a detailed investigation of the interactions between the fusion neutrons and the blanket that surrounds the thermonuclear plasma. Since the neutrons resulting from deuterium–tritium fusion have a kinetic energy of ~14.1 MeV, neutron cross-section data in the energy range generally considered unimportant in the design of a fission reactor is extremely important in the design of a fusion reactor. In general, the types of data needed are: (1) nonelastic cross sections in the energy range 1 to 15 MeV; (2) secondary-neutron spectra from elastic, inelastic, and (n,2n) events; and (3) secondary gamma-ray spectra from inelastic scattering, (n,2n) events, and epithermal capture. (auth)

890 (IPP-4/86) CALCULATION OF MAGNETIC FIELD LINES. INTRODUCTION TO USE OF THE PROGRAM; CALCULATION EXAMPLE. Poehlchen, R. (Institut fuer Plasmaphysik, G.m.b.H. Garching (West Germany)). May 1971. 31p. (In German). Dep. NTIS (U. S. Sales Only).

A computer code (FORTRAN, IBM 360/91) was developed for the calculation of magnetic field lines. The field generating system may consist of straight filament currents with finite length and arbitrary orientation in space, circular loops (thin-wire rings) or thick solenoids. A combination of the three above-named field-generating elements is also permissible, with the restriction (at the present stage of the program) that all loops

and solenoids must be coaxial to each other. A brief mathematical representation is followed by detailed instructions for use of the program and a number of examples with field-line plots. (auth)

891 (IPPJ-DT-24) PROCEEDINGS OF MEETING CONCERNING TECHNICAL PROBLEMS OF GENERATION AND CONTROL OF LARGE IMPULSE CURRENT. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1970. 102p. (In Japanese). (CONF-701220).

The meeting was held to study technical problems concerning generation and control of a large impulse current. A method to measure inductance of low-inductance condensers for fast theta pinches was reported. Three reports concerning current switching were presented, titles of which were: multiple arc gaps; trigger of gaps for large current discharge by laser beams; and partial discharge test of large-capacity, high-voltage OF condensers. Standardization of impulse current generators was discussed. Problems of the standardization of condensers, cables, switches, and trigger systems and countermeasures against induction were presented. Sodium cable was studied to reduce cost of power system. Condensers for the impulse current generation for nuclear fusion studies and element structure and dielectric material of condensers for impulse current discharge were introduced. Results of parallel operation of switches for theta discharge were reported. Specification and results of test operation of a small screw pinch system of the Electrotechnical Laboratory were also reported. Design study of JFT-2 (Japan Atomic Energy Research Institute Fusion Torus 2) was presented, and technical problems of a stellarator of Institute of Plasma Physics were investigated. (Japan)

892 (JAERI-Memo-4532) PROPERTIES OF TRIANGULARLY-SHAPED MAGNETIC SURFACES. Tanaka, Masatoshi; Tuda, Takasi (Japan Atomic Energy Research Inst., Tokyo). Aug 1971. 19p. Dep. NTIS (U. S. Sales Only).

Axisymmetric hydromagnetic equilibria with triangularly shaped magnetic surfaces and some of their properties (shear, magnetic well, local stability, critical beta, particle and thermal transports) are examined. A small triangular deformation of magnetic surfaces in combination with an elliptic component causes considerable deepening of the magnetic well and, thus, enhanced stability against local flute modes, compared with conventional tokamaks. The critical poloidal beta for equilibrium and particle and thermal transports are little influenced by a triangular component. (auth) (Japan)

893 (NP-19066) FUSION DEVICES FOR PLASMAS ROTATING AT SUPER-CRITICAL VELOCITIES. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Sep 1970. 17p. Dep. NTIS (U. S. Sales Only).

It is shown that the velocity limitation observed in at least some types of rotating plasma devices is caused by an enhanced plasma–neutral gas interaction at the end walls which bound the plasma in the magnetic field direction. A considerable amount of nonthermal ions should be produced by the backscatter of neutrals from these walls. If the mechanism underlying the plasma–neutral gas interaction is due to the generation of such ions, or to some other process which forms azimuthal electric field inhomogeneities, it should become possible to eliminate the velocity limitation by short-circuiting the azimuthal electric field. If these predictions are true, new possibilities will open up in the use of rotating plasmas. In particular, the power losses due to ions and electrons escaping from a rotating plasma device can then be kept small enough to balance the thermonuclear power at high temperatures. This would be the case for technically realizable beta values, plasma densities, and magnetic field strengths. At the same time a strong confinement can only be achieved by the centrifugal force at very large rotational velocities and applied voltages, the technical feasibility of which has to be further analyzed. (auth) (Sweden)

894 PULSED HIGH MAGNETIC FIELD GENERATION USING CAPACITIVE AND INDUCTIVE ENERGY STORAGE OR FLUX COMPRESSION. Schneider, Detlef; Salge, Juergen (Technische Univ., Brunswick). Z. Angew. Phys.; 31: No. 5-6, 346-59(1971). (In German).

At present, high magnetic fields above 250 kOe up to 25 MOe can only be generated for short duration (10^{-6} to 10^{-1} sec). Various shapes of magnetic fields can be realized by different energy-storage systems and coils. The magnetic field strength is limited by the available stored energy and the ability of the coil to withstand destruction due to mechanical stress, thermal heating, skin effect, magnetic shock wave, and electrical breakdown. High magnetic fields can be achieved also by magnetic-flux-compression techniques. Destroying effects, basic types of electrical generating circuits, coils, flux concentrators, flux-compression generators, and the present state of high magnetic pulse field generation are discussed. (auth)

895 DIVERTER FOR USE WITH PLASMA GUNS. Hughes, M. H.; Montague, R. G. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 13: No. 8, 691-4(Aug 1971).

P'asma guns have been developed for controlled thermonuclear research as a means of filling magnetic traps with dense hot plasma ($n \sim 10^{13}$ cm^{-3}, $T_i \sim 1$ keV); the plasma is guided into the trap by injecting along a magnetic guide field matched to the trap and the gun. However, in addition to hot plasma, most guns produce a comparable quantity of cold plasma that can enter the trap and interfere with the confinement of the hot component. Consequently, various schemes have been devised for separating the hot and cold plasma employing, for instance, magnetic stoppers or curved guide fields. A simple alternative device that diverts plasma with high efficiency is described here. (auth) (UK)

Wave Phenomena

Refer also to abstracts 824, 852, and 871.

896 (AEC-tr-7275) SPECTRA OF TURBULENCE OF WHISTLERS IN COLLISIONLESS PLASMA. Lifshits, M. A.; Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translation of report NP-18482. 16p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 51730. (M.O.W.)

897 (FRNC-TH-66) STUDY OF GRID-EXCITED ION WAVES IN A COLLISIONLESS PLASMA. Gresillon, Dominique (Paris Univ. (France). Faculte des Sciences). 1970. 96p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A linear microscopic theory of ion dynamics and waves in single-ended, collisionless Q machine plasmas is presented. The actual supersonic drifting plasma and the wave excitation method are taken into account. Attention is given to the following two main points. Firstly, the excitation coefficients for normal ion modes are calculated. Two main normal modes are found: one slower, the other faster than the plasma mean velocity. In the very-low-frequency limit, and near the source, their sum acts so as to give a free streaming of the modulated plasma flow. When going higher in frequency and farther from the source, the more-damped slow wave disappears, leaving only the fast one. Secondly, the first-order ion distribution is developed. This development makes explicit the general solution of the Vlasov equation as a sum of free mode and normal mode. The macroscopic behavior of these free modes is made responsible for the so-called "pseudo waves", which appear above the ion plasma frequency when normal modes are damped out. Experimental results are reported. Interest is directed to microscopic measurements in the wave, and preliminary results are given on the associated first-order distribution function. (France)

898 (ORNL-TM-3610) EVALUATION OF THE PLASMA DISPERSION FUNCTION. Ferguson, E. A. (Oak Ridge National Lab., Tenn.). Oct 1971. 18p. Dep. NTIS.

A new ORNL version of the FRDCNT subroutine, which evaluates the plasma dispersion function, was written. The routine uses numerical integration and an asymptotic expansion method. The new ORNL version of FRDCNT gives results which have relative errors less than 10^{-6} for all arguments for which the plasma dispersion function is greater than 10^{-4} and absolute errors less than 10^{-6} for all other arguments. The routine is written in FORTRAN using double precision. It has been optimized with respect to calculation time, and in comparison tests with other known codes for similar accuracy, checks out to be the fastest. (auth)

899 NONLINEAR DAMPING OF ELECTRON PLASMA WAVES BY INDUCED DECAY INTO ION WAVES. Franklin, R. N.; Hamberger, S. M.; Lampis, G.; Smith, G. J. (United Kingdom Atomic Energy Authority Research Group, Abingdon, Eng.). Phys. Rev. Lett.; 27: No. 17, 1119-23(25 Oct 1971).

Enhanced damping of an electron plasma wave due to induced nonlinear decay into a second electron wave plus an ion wave is demonstrated experimentally. The particular ion distribution allows decay into both positive and negative energy ion waves. The threshold for decay into the positive energy waves is shown to be consistent with theory. (auth)

900 KORTEWEG–DE VRIES EQUATION: TRANSITION PERIOD. Shih, L. Y. (National Research Council of Canada, Ottawa). J. Math. Phys. (N. Y.); 12: No. 10, 2124-6(Oct 1971).

A general form of the nonlinear wave equation with dispersive and dissipative terms involving small coefficients is treated for the transition period when the time is around the breakdown time. In the first part of this paper, some relations are established in order to see how the classical overtaking phenomenon is even-

tually prevented when the curve has steepened sufficiently. In the second part of this paper, the growth and damping of solitary waves due to the effects of dispersion and dissipation are analyzed. (auth)

901 PROBLEM OF NATURE OF LOW-FREQUENCY OSCILLATIONS IN BOUNDED LOW-PRESSURE PLASMA PLACED IN MAGNETIC FIELD. Pasechnik, L. L.; Popovich, A. S. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: 486-9(Mar 1971). (In Russian).

The interpretation of an excitation mechanism for intense, low-frequency oscillations is discussed. The frequency of the oscillations was established as a function of the length of the discharge chamber, the longitudinal profile of constant and alternating potentials, and the longitudinal profile of the plasma density. According to a scheme proposed by V. V. Vladimir the conditions of the excitation were calculated for the observed profiles of varying potential and density. The calculations confirm the fact that it is possible to treat the observed oscillations as a modification of longitudinal, ambipolar sound, dependent on the loss of ions at the end in an accelerating field applied from without. (tr-auth)

902 NON-LINEAR ANALYSIS OF CYCLOTRON WAVE EXCITATION DUE TO A BEAM. Kovtoune, R. J. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 13: No. 8, 637-44 (Aug 1971).

A nonlinear analysis of cyclotron-wave excitation in a plasma with a charged-particle beam is presented. The Langmuir frequency of plasma ω_p is assumed to be much smaller than the beam cyclotron frequency ω_c. A ratio of the wave magnetic field amplitude $\tilde{H}$ to the confining uniform magnetic field H_0 is also assumed to be small ($\epsilon = \tilde{H}_0/H_0 \ll 1$). The problem is analyzed without linearization, with the help of an asymptotic method. A frequency range of the unstable oscillations is determined, as well as the spatial and time development of the cyclotron instability. (auth) (UK)

903 MODULATION OF ELECTROMAGNETIC WAVES PROPAGATING IN PLASMA PLACED IN A VARIABLE MAGNETIC FIELD. Kats, L. I.; Starodubtsev, G. P. (Saratov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 4, 547-53(1971). (In Russian).

Modulation effects due to electromagnetic waves propagating in a plasma placed in the variable magnetic field are quantitatively estimated. The case of wave propagation normal to the magnetic field is considered. The advantages of such an effect in the design of modulation devices are compared with the case when the wave propagates along the magnetic field. (auth)

904 COUPLING BETWEEN THREE ELECTRON WAVES IN A PLASMA COLUMN. Leprince, P.; Moisan, M. (Laboratoire de Physiques des Plasmas, Orsay, France). Plasma Phys.; 13: No. 8, 659-66(Aug 1971).

By exciting the second Tonks–Dattner (or second secondary) resonance with a strong rf field, the emission of two frequencies is observed: one belonging to the third Tonks–Dattner resonance bandwidth and another related to the azimuthally symmetric cold (or main) mode. (auth) (UK)

905 SURFACE WAVES IN MAGNETOHYDRODYNAMICS GENERATED BY A TRAVELLING PRESSURE POINT. Bijlsma, S. J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Plasma Phys.; 13: No. 8, 681-7(Aug 1971).

The wave pattern created by a pressure point moving with constant velocity over the free surface of an inviscid MHD plasma bordered by a magnetic field is investigated. If the depth of the plasma is taken to be infinite, the results are the same as found in the case of an ordinary fluid provided that the velocity of the pressure point exceeds the Alfvén velocity. In this case a new expression is given for the surface elevation in front of the pressure point. Moreover, some new results are found in the cases of a fluid and a plasma of finite depth. (auth) (UK)

906 INSTABILITY OF ONE-DIMENSIONAL, OBLIQUE, MAGNETIC SHOCK STRUCTURES. Wright, Thomas P. (Sandia Labs., Albuquerque, N. Mex.). Phys. Fluids; 14: No. 11, 2337-40(Nov 1971).

It is shown that the whistler and/or electron-cyclotron structures, which have been observed in one-dimensional computer calculations, are unstable to decay by resonant three-wave interaction. The perturbing waves propagate at an angle to the primary wave. The conditions for instability to occur and the pertinent growth rates are presented. (auth)

907 SPREADING OF A PSEUDOWAVE FRONT. Alexeff, I. (Univ. of Tennessee, Knoxville. Oak Ridge National Lab., Tenn.); Estabrook, K.; Widner, M. Phys. Fluids; 14: No. 11, 2355-8(Nov 1971).

Using analytic, nonlinear techniques the spreading of the leading edge of a pseudowave (here assumed to be a slab of ions injected at hypersonic velocity into a dense background plasma) is computed. It is found that the front spreads due to collective effects with a characteristic velocity of $3(n_{20}/n_{10})^{1/3}v_a$, where n_{20} is the initial injected ion density, n_{10} is the background ion density, and v_a is the ion-acoustic velocity. The computation also predicts a finite leading edge velocity of $v_0 + 2(n_{20}/n_{10})^{1/3}v_a$, where v_0 is the initial velocity of injection. Neither shock steepening nor an accelerating leading edge as in a free expansion of plasma is found. (auth)

908 ION ACOUSTIC WAVES IN A MULTI-ION PLASMA. Fried, Burton D.; White, Roscoe B.; Samec, Thomas K. (Univ. of California, Los Angeles). Phys. Fluids; 14: No. 11, 2388-92(Nov 1971).

An exact treatment of the multispecies ion acoustic dispersion relation is given for an argon/helium plasma. Phase velocity and damping are obtained as a function of ion–electron temperature ratio and relative densities of the two species. There are two important modes in the plasma, with quite different phase velocities, which are referred to as principal heavy ion mode and principal light ion mode. Which of these is dominant depends on the relative densities of the two components, but, in general, the light-ion mode becomes important for suprisingly small light-ion contamination. Approximate analytic expressions are derived from damping rates and phase velocities and their domains of validity are investigated. Relevance of the results for the investigation of collisionless shocks is discussed. (auth)

909 FORMATION OF STATIONARY LARGE AMPLITUDE WAVES IN PLASMAS. Manheimer, Wallace M. (Naval Research Lab., Washington, D. C.); Flynn, Robert W. Phys. Fluids; 14: No. 11, 2393-6(Nov 1971).

Several recent nonlinear theories of one-dimensional plasmas have suggested that a stable or unstable electrostatic wave can evolve into a Bernstein–Greene–Kruskal mode. Generally, the distribution function of the total energy of a particle is computed. The self-consistency of these computed distributions is examined here by solving Poisson's equation. It turns out that the system is self-consistent only if frequency shifts are incorporated in the theory. (auth)

910 MODIFICATION OF ELECTROMAGNETIC FIELD IN AN UNDERDENSE TURBULENT PLASMA. Shkarofsky, I. P.; Ghosh, A. K. (RCA Ltd., Montreal). Phys. Fluids; 14: No. 11, 2475-86(Nov 1971).

The modification of a microwave signal propagating transversely through a turbulent jet using a movable-antenna receiver within the plasma is observed. The plasma is very underdense. The turbulence produces an additional 15 to 20% attenuation of the coherent signal with a corresponding buildup of the incoherent energy, in agreement with theoretical predictions based on the turbulent density profile and the scale length as measured by electrostatic probes. The two quadrature components of the field are individually detected as well as their mean square values, their correlation functions, and spectrum functions. There are some details that disagree with theory, in particular, the observation of negative cross correlation between the two quadrature field components. The incoherent signal is observed, as a function of penetration distance, to go through the transition from elliptical, with mainly phase fluctuation, to "crescent" shaped with a stronger preference toward one end, and finally to a quasi-circular type of noise. (auth)

911 PARAMETRIC OSCILLATIONS OF A HOT MAGNETIZED PLASMA. Bajwa, G. S.; Srivastava, K. M. (Univ. of Jodhpur, India). Phys. Fluids; 14: No. 11, 2436-9(Nov 1971).

The parametric excitation of a hot plasma subjected to an externally imposed spatially uniform electric field and to a constant uniform magnetic field is considered. For transverse propagations perpendicular to the applied electric field, it is found that instabilities may occur for frequency $\omega + n\nu \approx \omega_0$, where ω_0 and ν are, respectively, the plasma frequency and the electric field frequency. (auth)

912 PULSE-STIMULATED EMISSION AND ECHOES AT UPPER HYBRID RESONANCE. Henderson, D. M. (Yale Univ., New Haven). Phys. Fluids; 14: No. 11, 2512-22(Nov 1971).

An experimental study of the interaction at upper-hybrid resonance of high-frequency radiation with a low-temperature spatially inhomogeneous plasma is presented. This interaction is investigated through single-pulse-stimulated emission and two pulse echoes observed in an afterglow plasma column placed in a uniform, static magnetic field. A theoretical treatment of the linear response of a one-dimensional plasma slab in the zero-temperature approximation is given. This theory predicts that a long-lived

radiation signal at the maximum upper-hybrid frequency of the inhomogeneous profile is excited by a microwave pulse and decays by phase mixing. Experimental evidence to support the theory is given, especially those aspects which are essential to echo formation. Several nonlinear processes of echo formation are investigated. Based on an approximate collision model for argon, a theory is developed for upper-hybrid echoes in a low-density plasma arising from velocity-dependent electron–neutral collisions. The observed echoes in argon are compared both with this theory and with the theory of Blum and Bauer for echoes from nonlinear upper-hybrid oscillations. Under these experimental conditions, the collisional nonlinearity dominates. (auth)

913 NONLINEAR RESONANCE ABSORPTION IN GAS-DISCHARGED PLASMA. Gil'denburg, V. B.; Markov, G. A.; Shishko, A. Ya. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 4, 629-34(1971). (In Russian).

The nonlinear resonance absorption of an H_{01} wave in a rectangular waveguide by an axially magnetized positive column of gaseous discharge crossing the waveguide perpendicular to its narrow wall was studied. The hysteresis dependence of the absorbed power (W) on the incident power (W_0) at different discharge currents determining the initial (undisturbed by hf field) electron density is registered. The hysteresis is associated with transition of the density (increasing when hf power is applied) through the resonance values corresponding to the so-called plasma-cyclinder main dipole resonance split in the static magnetic field. The large values of the relative absorption reached at the resonance in the linear regime ($W/W_0 \sim 80$ to 90%) are set also in a specific branch of the ambiguous dependence $W(W_0)$ beginning from $W_0 \sim 5$ W and up to the upper limit of the investigated power range ($W_0 \sim 30$ W). This is a realization of the self-holding resonance state in the nonlinear regime with the effective transmission of hf field energy to plasma. A qualitative theoretical interpretation is given of the observed hysteresis phenomena based on the effect of replacing the dc Joule losses by hf losses. (auth)

914 ELECTRON CYCLOTRON DAMPING IN A LOW DENSITY PLASMA. Nakamura, Sadao; Kubo, Hiroshi; Mitani, Kenji (Kyoto Univ.). J. Phys. Soc. Jap.; 31: No. 5, 1539-43(Nov 1971).

The damping of right (R)-hand circularly polarized microwaves through a magnetized cesium plasma was investigated experimentally. The R wave damps sharply at electron cyclotron frequency ω_c, and its power absorption coefficient and refractive index are about 0.33/cm and 1.0, respectively, under the conditions of $(\omega_p/\omega)^2 = 9.8 \times 10^{-3}$ and $T_e = 3500$ K, where ω_p/ω and T_e are the normalized electron density and the electron temperature. These results are in reasonable agreement with the electron cyclotron damping predicted by the hot plasma theory. (auth)

Radiation Physics and Shielding

Refer also to abstracts 248, 1129, 1563–1565, and 1601.

Radiation Physics

Refer also to abstracts 983 and 1317.

915 (UJV-2532-R-F) CALCULATION OF THE CRITICAL PARAMETER OF INFINITE SLAB BASED ON THE ONE-SPEED TRANSPORT EQUATION. Rocek, J.; Prokop, K. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov 1970. 15p. INIS.

The discrete integral transport method proposed by Carlvik was used for numerical solution of the transport equation in one-dimensional systems and in the monoenergetic case. The method is characterized by a discrete representation of space and the use of point-to-point transport kernels, which make possible the Gaussian integration over the coordinate. General theory and formulas are given for plane geometry and the monoenergetic case. (INIS)

916 PARTICULAR SOLUTIONS IN MULTIGROUP TRANSPORT THEORY. Leuthaeuser, K. D. (Univ., Kiel). Atomkernenergie; 18: No. 2, 158-64(1971).

A set of coupled multigroup transport equations may be considered as a system of inhomogeneous one-speed transport equations. Typical source terms are of the general form $x^n \exp(-x/\eta) \Sigma_{l=0}^{L} \beta_l P_l(\mu)$, where η may be any complex number and β_l are certain expansion coefficients. Particular solutions corresponding to these inhomogeneous terms are constructed in two different ways. The first method is straightforward, and is based upon the one-velocity infinite-medium Green's function. However, results derived in this way are rather complicated in general, and a simplification, if possible at all, requires lengthy contour integrations. Therefore, a more direct method is proposed, yielding recurrence formulas for anisotropic scattering of any degree L and any source exponent n. (auth)

917 MONTE CARLO SIMULATIONS OF BEHAVIOR OF ENERGETIC LIGHT IONS IN SOLIDS. Ishitani, Tohru; Murata, Kenji; Shimizu, Ryuichi (Osaka Univ.). Jap. J. Appl. Phys.; 10: No. 10, 1464(Oct 1971).

The Monte Carlo method was used to depict the trajectories of 30-keV protons incident on Al, Cu, and Au. The trajectories, based on the single-scattering model, were drawn by a plotter connected with a digital computer. (D.L.C.)

918 CHARACTERISTICS OF REVERSE-SCATTERED BETATRON RADIATION AS A FUNCTION OF SCATTERING MATERIAL AND THICKNESS. Golikov, E. G.; Zol'nikov, P. P.; Dvinyaninov, B. L.; Sukhanova, K. A. Sov. J. Nondestruc. Test. (Engl. Transl.); No. 3, 359-60(May-Jun 1969).

Translated from Defektoskopiya; No. 3, 159-60(May-Jun 1969).

An experimental study was made of the intensity and spectral composition of reflected betatron radiation as a function of reflector material and thickness. Flat reflectors of organic glass, Al, steel, and Pb were used, and the energy of the primary bremsstrahlung was either 9 or 15 MeV. After the initial linear slope at small thickness, the number of pulses reaches saturation at a saturation thickness that depends on the energy of the scattered γ quanta. The number of reflected γ quanta changes little with the target atomic number, although it drops sharply for Pb. The primary radiation energy has little effect on the saturation thickness. The results can be explained by absorption of the scattered radiation. (D.L.C.)

919 PRECISE DEDUCTION OF THE SYNCHROTRON RADIATION FORMULA. Sokolov, A. A.; Gal'tsov, D. V.; Kolesnikova, M. M. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 14-24(1971). (In Russian).

A precise formula is given for the radiation energy of a moving charge along a circle or spiral (without resolution along any given parameter). This method is extremely perspective for a macrosystem under consideration, when the observer may be situated quite near the source at the beginning of a wave region. The formula may be used for coherent electron radiation. (tr-auth)

920 EFFECTIVE ATOMIC NUMBERS IN COMPOUNDS. Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys.; 6: No. 10, 574-5(Oct 1968).

Effective atomic numbers for gamma-ray total interactions in water and Perspex were determined in the energy region from 30 to 1332 keV. It was found that the high value at low energies is due to the possibility of the contributions of photoelectric and coherent scattering processes whose atomic numbers are higher than that of incoherent scattering. As the energy increases the number decreases and finally reaches, more or less, a steady value as the entire gamma-ray interaction is mostly due to incoherent scattering only. (auth)

Shielding

Refer also to abstracts 1086 and 1096.

921 SHIELDING AGAINST HIGH ENERGY PARTICLES. Barbier, Marcel (European Organization for Nuclear Research, Geneva). Ind. At.; 15: No. 2, 41-8(May 1971). (In French).

An analytical method, which does not use Monte Carlo procedures, is given for calculating extranuclear hadron cascades in shields. It is assumed that hadron absorption is due entirely to nuclear interaction and that the cross section is energy-independent and the same for all types of hadrons. A secondary-particle production function is defined, $F(E_k, E)\,dE$, which gives the number of secondaries produced in the energy interval E, E + dE by an incident hadron of energy E_k. From this function the populations of the successive generations of hadrons in the cascade, as well as their spatial distribution and their energy spectra, can be calculated. It is shown that the energy spectrum of each generation is conserved throughout the shield. On the assumption that all particles in the cascade are pions, the numbers and energy spectra of the muons resulting from in-flight pion decay can be deduced. (France)

922 RECOMMENDATION FOR DATA ON SHIELDING FROM IONIZING RADIATION. PART 2. SHIELDING FROM X-RADIATION. BS 4094 Pt. 2 1971. London; British Standards Institution (1971). 81p. Available from American National Standards Institute, New York.

Barriers against the primary x-ray beam are calculated, and the data that permit the calculation to be carried out are provided. The secondary barriers required against scattered and against

leakage radiation are calculated. Methods and data for the calculation of barriers against bremsstrahlung radiation, arising from electron beams or beta particles from radionuclides are given. Guidance is given on the secondary hazards associated with high-energy x-ray generators, namely: the production of neutrons, noxious gases and radiation arising from the activation of materials, radiation damage, and the fire risk. Guidance on the design of shielded rooms is given. (M.H.R.)

923 SPATIAL DISTRIBUTIONS OF NEUTRONS AND PHOTONS IN A DUCT FILLED WITH A HELICAL IRON PLUG. Nakamura, Takashi; Kanazawa, Takashi; Hayashi, Yo; Hyodo, Tomonori (Kyoto Univ.). J. Nucl. Sci. Tech. (Tokyo); 8: No. 9, 481-91(Sep 1971).

The spatial distributions of neutrons and photons were studied in a cylindrical duct through a simulated iron/water multilayered shield filled with an iron plug on which six helical grooves were cut at regular intervals and with pitches of 22, 44, 88 or 176 cm. The results obtained are discussed in relation to the three aspects of axial distribution, cross-sectional distribution and streaming. It is shown that the axial distributions of the fast neutrons and photons agree with an exponential law, while those of the thermal and epithermal neutrons are the sum of two exponential functions. It was found that the cross-sectional distributions of neutrons and photons have quite a sharp peak on the beam axis, indicating that the transmission through the duct is more important than the scattering and diffusion in the duct. The streaming effect along the helical grooves is not very marked in any of the cases, because of the large volume fraction of the iron plug to the total duct volume (79 ~ 89%). (auth)

924 SPECIFICATION FOR LEAD BRICKS FOR RADIATION SHIELDING. BS 4513 1969. London; British Standards Institution (1969). 17p. Available from American National Standards Institute, New York.

Specifications are given for metric dimensions for lead shielding bricks. Two systems are considered: a chevron system, and a rounded mating surface system. (M.H.R.)

Solid-State Physics

Refer also to abstracts 654 and 1397.

Radiation Effects

Refer also to abstracts 229, 385, 412, 413, 565–567, and 647.

925 (IAE–2005) INFLUENCE OF HIGH-ENERGY PARTICLE-INDUCED DAMAGE REGIONS ON SEMICONDUCTOR THERMAL CONDUCTIVITY. Litvinov, V. L.; Ukhin, N. A. (Institut Atomnoi Energii, Moscow (USSR)). 1970. 28p. (In Russian). INIS.

The effect of damaged regions resulting from fast neutrons was investigated on the thermal conductivity of germanium and silicon. It was concluded that a change in thermal conductivity at low temperatures indicates the presence of a damaged region, but a conventional calculation of its extent was incorrect. (tr-auth)

926 RAMAN SCATTERING AND FAR-INFRARED ABSORPTION IN NEUTRON-COMPACTED SILICA. Stolen, R. H.; Krause, J. T.; Kurkjian, C. R. (Bell Telephone Labs., Holmdel, N. J.). Discuss. Faraday Soc.; No. 50, 103-7(1970).

In vitreous silica, that has been compacted by irradiation with fast neutrons, the ultrasonic absorption, the excess heat capacity, and the magnitude of the negative coefficient of thermal expansion decrease. Measurements of the far-infrared absorption and Raman scattering in such neutron-compacted silica are now reported. These results are correlated with new measurements of ultrasonic absorption and thermal expansion in the same material. The results are consistent with an interpretation based on a decrease in the number of low-frequency modes. (auth) (UK)

927 STUDY OF THE MECHANISM OF IMPURITY AND RADIATION STRENGTHENING OF LiF CRYSTALS BY THE METHOD OF THERMALLY STIMULATED ELECTRON EMISSION. Knab, G. G.; Urusovskaya, A. A. (Inst. of Crystallography, Moscow). Sov. Phys. Cryst. (Engl. Transl.); 16: No. 2, 313-17(Sep-Oct 1971).

Translated from Kristallografiya; 16: No. 2, 382-7(Mar-Apr 1971).

A comparison is given of the mechanical and emission properties of LiF crystals in the pure condition and containing Mg impurity when subjected to various heat treatments. An understanding of the reason for impurity and radiation strengthening and softening is rendered possible from the data obtained. (auth)

928 LOW-TEMPERATURE QUENCHING OF THE PHOTOMECHANICAL EFFECT IN γ-IRRADIATED NaCl CRYSTALS. Ermakov, G. A.; Nadgornyi, E. M. (Inst. of Solid State Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 14: No. 1, 29-32 (5 Jul 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 1, 45-9(5 Jul 1971).

The effects of infrared illumination on the F-light-induced change of the flow stress of γ-irradiated NaCl crystals were studied at low temperatures. The F light produces a reversible change in the reduced shear stress, and additional illumination by the infrared reduced the stress change. This infrared-quenching effect occurs only at temperatures below 70°K and is at a maximum near 1.8 μ. A model is proposed to explain this effect. (D.L.C.)

929 STUDIES ON OPTICAL BLEACHING OF X-RAY-IRRADIATED NaCl CRYSTALS. Vijayalakshmi, K.; Kuchela, K. N. (Univ. of Bangalore, India). Curr. Sci. (India); 40: No. 19, 511-14(5 Oct 1971).

The regions of fast first-stage bleaching and the slow second-stage bleaching of F-centers in as-cleaved x-irradiated NaCl crystals at room temperature are not clearly separated out in the optical bleaching curves. These curves are explained by a simple relation of the form $\Delta\alpha_F \alpha_{F_0} = k \log t$, $\Delta\alpha_F$ being the change in absorption coefficient at the F-band peak after bleaching the colored crystal for t minutes, α_{F_0} being the absorption coefficient at the F-band peak before bleaching, and k being the constant dependent on the time of x irradiation. The two regions are distinctly separated out in the case of heat-treated NaCl crystals. A possible mechanism of bleaching is suggested to explain the results of optical bleaching. (auth)

930 METHOD OF BULK IRRADIATION OF THIN SAMPLES OF MATERIALS OF DIFFERENT CHEMICAL COMPOSITION BY HIGH-ENERGY BREMSSTRAHLUNG. Gelashvili, Sh. Sh. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 63: No. 1, 61-4(Jul 1971). (In Russian).

It is shown that, by means of a specific combination of samples in blocks according to their composition, thickness, and position, the thickness of irradiated samples may be considerably increased (10 to 11 times) and the duration of exposure simultaneously decreased (7 to 8 times) at a given value of inhomogeneity in the depth distribution of absorbed energy. (auth)

931 INTERACTION BETWEEN LUMINESCENCE AND TRAPPING CENTERS IN ZnS CRYSTAL PHOSPHORS IRRADIATED BY NEUTRONS. Okonechnikov, A. P.; Gavrilov, F. F.; Pilipenko, G. I. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 133-4(1971). (In Russian).

Photosensitive optically absorptive bands are formed in ZnS by irradiation with neutrons or electrons. Experiments were conducted to establish a relation between color centers and the luminescence of these crystallophosphors. After irradiation with fast neutrons at 10^{18} n/cm^2 at 77°K, absorption maxima were detected at 360, 390, 430, and 540 nm. The absorption at 430 and 540 nm was measured as a function of temperature over the range 77 to 350°K, and a maximum in the optical density was observed at 233°K. Such absorption bands are associated with deep-seated electron traps. A decrease in the luminescent properties of phosphors at sufficiently low temperatures is the result of electron capture, leading to a decrease in the number of centers that participate in luminescence. (K.S.W.)

932 COMPUTER STUDIES OF DECHANNELING EFFECTS ON ION IMPLANTATION PROFILES. Desalvo, A.; Rosa, R.; Zignani, F. (CNR, Bologna). Lett. Nuovo Cim.; 2: No. 8, 390-4(21 Aug 1971).

Some preliminary results are reported on computer calculations of the penetration profile of ions implanted under channeling conditions. The features of the computer model are outlined. Calculations were carried out for 40-keV phosphorus ions penetrating along the [110] channel in silicon. (W.D.M.)

933 LUMINESCENCE OF KBr–KI SOLID SOLUTIONS UNDER X-RAY IRRADIATION AT LIQUID HELIUM TEMPERATURE. Wakita, Shohei (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 31: No. 5, 1505-12(Nov 1971).

The luminescence of KBr crystals containing KI of various concentrations between 0 and 100 mole % under x-ray irradiation and uv illumination was investigated at liquid-helium temperature. The two characteristic emission bands are observed at about 3.50 and 4.30 eV. The former band at 3.50 eV is shown to originate from the recombination of an electron with the self-trapped hole of the complex V_k center, IBr^-, and is π-polarized with a degree of polarization $P = -0.15 \pm 0.03$. From the excitation spectra for this band by uv illumination, a possibility of energy transfer be-

tween excited Br^- ions and I^- ions is discussed. The latter band at 4.30 eV is due to a cluster of I^- ions. (auth)

934 CHANNELING STUDY OF THE STRUCTURE OF U_4O_9. Matzke, Hj. (European Inst. for Transuranium Elements, Karlsruhe, Ger.); Davies, J. A.; Johansson, N. G. E. Can. J. Phys.; 49: No. 17, 2215-26(1 Sep 1971). (AECL-3921).

The channeling behavior of 1-MeV He^+ ions and deuterons in U_4O_9 was studied in order to provide information on the location of the excess oxygen in the fluorite structure of UO_2. Wide-angle (Rutherford) scattering was used to study the channeling behavior with respect to the uranium sublattice, and the $^{16}O(d,p)^{17}O$ reaction was used to investigate the oxygen sublattice. A pronounced disorder in the oxygen sublattice was indicated by very poor channeling properties and strong dechanneling with increasing depth. The data are thus in conflict with the model incorporating the excess oxygen in the regular interstitial positions along the ⟨100⟩ uranium rows; on the other hand, they are consistent with the more recent model of Willis in which the excess oxygen atoms are displaced ~1Å from the regular interstitial sites and displace, in addition, some normal oxygen atoms. Channeling with respect to the uranium sublattice was found to be substantially the same as in stoichiometric UO_2—but with a somewhat smaller critical angle, indicating that the uranium atoms may be displaced slightly (i.e., ~0.25 Å) by the presence of the excess oxygen. (auth) (Canada)

935 DOPING DEPENDENCE OF THE LINEWIDTH OF SPONTANEOUS EMISSION FROM ELECTRON-BEAM-EXCITED n-TYPE GaAs AT 300°K. Rakshit, S.; Biswas, S. N.; Chakravarti, A. N. (University Coll. of Science and Tech., Calcutta). Phys. Lett.; 37A: No. 1, 64-6(25 Oct 1971).

The doping dependence of the linewidth of spontaneous emission from n-type GaAs excited by a 40-kV electron beam at 300°K is theoretically determined. It is found that the dependence is in reasonable agreement with the experimental observation only when the effect of reabsorption of photons is taken into consideration. (auth)

936 EFFECT OF CHANNELING ON THE PROTOLUMINESCENCE OF KC1(T1) CRYSTALS. Huzimura, R. (Nara Univ. of Education, Japan); Ato, Y.; Miyagawa, S. Phys. Lett.; 37A: No. 1, 81-2(25 Oct 1971).

The ⟨100⟩ channeling-induced peak in the protoluminescence of KCl(Tl) is studied through the angular-half width and the rate of the increase in luminescence efficiency. The result gives the relative channel stopping power. (auth)

937 GAMMA-RAY INDUCED CONDUCTIVITY IN POLYMER INSULATING MATERIALS. Yahagi, Kichinosuke (Waseda Univ., Tokyo). Mem. Sch. Sci, Eng., Waseda Univ.; No. 34, 71-105(1970).

Electrical conduction under gamma-ray irradiation from ^{60}Co in polyethylene, Teflon, and hydrocarbon liquid was experimentally investigated as functions of temperature, gamma dose rate, preirradiation dose of high-energy electron beams, degree of graft in grafted polyethylene, applied voltage, etc. The conduction process in polyethylene is mainly discussed with regard to the movement of electrons as charge carriers. (auth) (Japan)

938 IRRADIATION DEFECTS AND ELECTRICAL QUALITY OF ION-IMPLANTED SILICON. Davies, D. Eirug; Roosild, S. (Air Force Cambridge Research Labs., Bedford, Mass.). Solid-State Electron.; 14: No. 10, 975-83(Oct 1971).

Ion-irradiated silicon that had been annealed to recover the lattice disorder was examined for residual electrically active defects. To do so, minority carrier lifetimes were monitored by measuring the switching behavior of planar diffused that were damaged with silicon or carbon ions on their low-doped side. Defects stable to temperatures well beyond those normally associated with lattice-disorder annealing were found throughout the investigated dose range of 10^{12} to 10^{15} ions cm^{-2}. With appropriate higher-temperature annealing, the deteriorated lifetime was shown to recover sufficiently so as not to restrict the use of implantation for fabricating devices. The accompanying compensating properties expected of these defects also explain many of the features in the manner by which the conductance of boron, phosphorus, and arsenic-implanted layers increase on annealing. (auth) (UK)

939 HOLE TRAPS IN ANTHRACENE SINGLE CRYSTALS PRODUCED BY ELECTRON BEAM IRRADIATION. Akasaka, Y.; Masuda, K.; Namba, S. (Osaka Univ.). Denki Gakkai Zasshi; 91: No. 5, 926-31(May 1971). (In Japanese).

Single crystals of anthracene, made by the Bridgeman method after zone refining, were irradiated with a 1.5-MeV electron beam at 77°K and at room temperature. Measurement of photoconductivity of the irradiated anthracene indicated that hole traps are formed by the irradiation. These hole traps are associated with an energy level about 0.18 eV lower than that of the first activated level of the mono-fold term. Results of ESR measurement indicated that these traps are formed by dibenzocyclohexadienyl radicals ($C_{14}H_{11}$) or anthracene dimers (bianthryl). A similar process of defect formation was also obtained with naphthalene. Namely, ESR signals indicated that α-naphthyl radicals are formed by the irradiation with electron beams of 10^7 to 10^8 rad at 1.5×10^5/rad/sec. Neutron irradiation for ESR was made at 10 to 17°K at 5×10^{14}/n/cm^2 by the use of neutrons emitted from a nuclear reactor. Optical absorption spectra of anthracene before and after the irradiation were also studied. (Japan)

940 RADIATION INTENSITY DEPENDENCE OF FIRST-STAGE F COLOURING IN NaCl. Agullo-Lopez, F.; Sanchez, C. (JEN, Madrid). J. Phys., C (London); 4: No. 13, 1660-4(17 Sep 1971).

The dependence of the saturation level of the first-stage F coloring of γ-irradiated sodium chloride on the γ radiation intensity (in the range 250 to 3×10^4 R min^{-1}) is quantitatively explained. The proposed model takes into account, in addition to the irradiation-induced mechanisms, a thermally activated process of free-anion vacancy trapping, whose main characteristics have been reported previously. (auth) (UK)

941 EFFECTS OF INTERRUPTED NEUTRON IRRADIATION ON STRAIN-AMPLITUDE-DEPENDENT INTERNAL FRICTION IN NaCl. French, I. E. (Univ. of New South Wales, Kensington, Australia). J. Phys., C (London); 4: No. 13, 1725-33 (17 Sep 1971).

NaCl single crystals were subjected to fast-neutron irradiations during which the neutron beam was interrupted for a specific time interval. The variation of crystal decrement with strain amplitude (for strain amplitudes between 5×10^{-8} and 5×10^{-6}) was measured during the interrupted irradiations. Similar experiments were carried out at a number of temperatures between –16 and 22°C. The results were analysed in terms of the theory of strain-amplitude-dependent internal friction developed by Granato and Lücke (J. Appl. Phys. 27: 583 and 789(1956)). This theory yielded the variation with time in the number of pinning points added to each original dislocation loop. When the irradiation was interrupted a decrease occurred in the pinning point number. This decrease reached completion within 1 minute at temperatures below 17°C, but required about 4 minutes to reach completion at higher temperatures. An explanation for this effect is offered that involves recombination of the pinning point parts. (auth) (UK)

942 HIGH-DOSE PROTON IRRADIATION OF ALKALI HALIDES. Hughes, A. E.; Pooley, D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 4: No. 14, 1963-76(7 Oct 1971).

Optical measurements were made of the concentration of F and other color centres produced in alkali halides by proton irradiation in the energy range 100 to 400 keV. A new treatment is given of a model of interstitial–vacancy recombination at high defect concentration which appears to explain many of the features of the approach to a saturation level of defects. At ambient temperatures, F-aggregate centre formation is considered as the process which ultimately produces a real saturation in the F centre concentration. At low temperatures, the limiting process is thought to be the formation of substitutional hydrogen ions (U centres), as protons are captured by F centres. The observation of infrared absorption associated with substitutional hydrogen ions confirms that this combination of protons with F centres does occur, and may also contribute to the fall in F centre concentration which follows saturation. (auth) (UK)

943 PHOTOLUMINESCENCE ASSOCIATED WITH THE 1.673-1.944- AND 2.498-eV CENTRES IN DIAMOND. Clark, C. D.; Norris, C. A. (Univ. of Reading, Eng.). J. Phys., C (London); 4: No. 14, 2223-9(7 Oct 1971).

Measurements are reported of photoluminescence from three defect centres in diamond which have characteristic absorption and emission lines at 1.673, 1.944, and 2.498 eV, respectively. When excited with plane polarized light, the emission from the 1.673-eV centre was found to be unpolarized in agreement with a centre possessing tetrahedral symmetry. Analysis of the polarization of emission of the other centres suggests that the symmetry of the 1.944-eV centre is either monoclinic I or trigonal, and that of the 2.498-eV centre is monoclinic I. A comparison of the absorption and excitation spectra indicates that the absorption lines at 2.887 and 2.954 eV and a broad absorption extending from 2.8 eV to higher energies are all associated with the 1.673-eV defect. (auth) (UK)

944 ELECTRON SPIN RESONANCE OF ELECTRON-IRRADIATED GERMANIUM DIOXIDE. Garlick, G. F. J.; Nicholls, J. E.; Oezer, A. M. (Univ. of Hull, Eng.). J. Phys., C (London); 4: No. 14, 2230-9(7 Oct 1971).

Irradiation of hexagonal germanium dioxide by fast electrons was found to produce two paramagnetic centres. These are the oxygen vacancy, and the other is tentatively assigned to an oxygen vacancy–interstitial pair. The threshold energy for the production of both centres is 120 ± 5 keV, corresponding to a displacement energy for the oxygen atom of 18.1 ± 0.1 eV. Annealing studies yield a unique activation energy of 1.1 eV at temperatures above 450°K for the retrapping of electrons at the oxygen vacancy. Below this temperature no unique activation energy for the annihilation of the vacancy by mobile oxygen atoms was found. For the supposed oxygen vacancy–interstitial pair, two activation energies of 0.4 and 0.8 eV were found, corresponding to the displacement of oxygen atoms to two different interstitial sites. (auth) (UK)

945 AUTOIONIC MICROSCOPY OF RADIATION DEFECTS IN MONOCRYSTALS. Suvorov, A. L. (Inst. of Theoretical and Experimental Physics, Moscow). Usp. Fiz. Nauk; 101: 21-52(May 1970). (In Russian).

The autoionic microscope is a unique apparatus, permitting direct observation of atomic levels of the surfaces of metal needle-like forms. Truly fantastic increases in performance may be achieved by adjusting electric field strengths at various surface shapes. Direct investigation of crystal defects as to their distribution and atomic configurations, as well as their concentration, is most promising in the region of autoionic microscopy. This review is dedicated to investigation of radiation-induced defects with the ionic projector and includes irradiation effects on refractory metals by neutrons, heavy charged particles, fission fragments, neutral atoms, and electrons. Formulation of questions and carrying out the experiments, identification of different kinds of defects on the ionic images, and clarification of their causes of formation are also examined. The main factors that introduce errors in autoionic microscope investigations of defects are analyzed. 91 references. (tr-auth)

946 RADIATION EFFECTS ON LATTICE DEFECTS. Lintner, K.; Schmid, E. (Univ., Vienna). pp 137-70 of Plenarvortraege. Stuttgart; B. G. Teubner (1969). (In German).

From thirty-fourth physicists conference; Salzburg, Austria (29 Sep 1969). See CONF-690975.

The effects of particle radiation on properties of solids, whereby special emphasis is focused on the nature and the action of produced lattice defects, are surveyed. As an introduction, examples are given of particle radiation effects on structural material with respect to their technological significance. Subsequently, the type of radiation-produced lattice defects is discussed as well as their interaction with each other and with previously existing defects. Also treated are both theoretical prediction of defects and experimental demonstration. Finally, regeneration of lattice defects is discussed from a theoretical as well as from an experimental standpoint. (H.B.G.)

Physical Properties

Refer also to abstracts 488 and 751.

947 (CONF-711108-1) MAGNETIC FORM FACTOR FOR METALLIC GADOLINIUM. Davis, H. L.; Cooke, J. F. (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 6p. Dep. NTIS.

From Conference on magnetism; Chicago, Ill. (16 Nov 1971).

Magnetic form factor calculations were performed using 4f wave functions obtained from relativistic Hartree–Fock–Slater calculations for free and Wigner–Seitz gadolinium atoms and ions. Only small differences exist between the results for free Gd^0 and free Gd^{3+}, and between free-atom and Wigner–Seitz results for Gd^0; however, significant changes are observed as the amount of exchange is varied in the Hartree–Fock–Slater calculation. Comparing the results with previous calculations and the recent experiments of Moon et al. led to the conclusion that conduction-electron screening produces only minor effects on the form factor, with the major difference between experiment and previous calculation probably being due to indirect relativistic screening. (auth)

948 (COO-1441-13) TEMPERATURE DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY OF NONSTOICHIOMETRIC $Ce_{1+y}O_2$. Blumenthal, R. N.; Hofmaier, R. L. (Marquette Univ., Milwaukee, Wis. Coll. of Engineering). [1971]. 35p. Dep. NTIS.

The electrical conductivity of sintered specimens of nonstoichiometric $Ce_{1+y}O_2$ was measured as a function of temperature from 1000 to 300°C as well as a function of composition over the range $0.00214 \leq y \leq 0.0977$. These results were described in terms of a high-temperature and low-temperature region. In both temperature regions, the conductivity exhibits an exponential dependence on temperature: $\sigma = \sigma_0 e^{-Q/kT}$. In the high-temperature region, the activation energy increased with increasing values of y (i.e. 0.22 eV at y = 0.00214 to 0.37 eV at y = 0.098). The activation energy, 0.61 ± .03 eV, in the low-temperature region was independent of y. The temperature of the intersection between the high- and low-temperature regions for each composition was compared with the composition–temperature dependence of the miscibility gap reported by Brauer and Gingerich. The temperature dependence of the conductivity in the high-temperature region was attributed to a change in both the carrier concentration and carrier mobility. An approximate value of the standard enthalpy of formation for the defect reaction $Ce_{Ce} = Ce_i \cdots = Ce_i \cdots\cdot + Ce'_{Ce}$ was determined to be $\Delta H = 1.6$ eV from the temperature dependence of the conductivity in this study and from the temperature dependence of the electron mobility reported in the literature. (auth)

949 (COO–1441-14) ELECTRICAL CONDUCTIVITY OF CaO-DOPED NONSTOICHIOMETRIC $Ce_{1+y}O_2$ FROM 700° TO 1500°C. Brugner, F. S.; Blumenthal, R. N. (Marquette Univ., Milwaukee, Wis, Coll. of Engineering). [1971]. 30p. Dep. NTIS.

The electrical conductivity of sintered specimens of CaO-doped CeO_2 (0.1 to 7.0 mole %) was measured over the temperature range 700 to 1500°C and from 1 to 10^{-22} atm of oxygen. All specimens of CaO-doped CeO_2 exhibited mixed conduction. Predominantly ionic conductivity was observed at low temperatures and high oxygen partial pressures. Conversely, high temperatures and lower oxygen partial pressures were dominated by electronic conductivity. In the CaO-content temperature and oxygen-pressure regions investigated, the electronic conductivity was rationalized in terms of a defect model involving nonstoichiometric defects (ionized cerium interstitials and localized electrons) and impurity-generated defects (doubly ionized oxygen vacancies). Good agreement was obtained between the theoretically derived relation $\sigma = \sigma_{oe}(1 - \bar{\xi}a) + A(\%CaO)\exp(-E_i/kT)$ and the electrical conductivity data, where the electronic conductivity of nonstoichiometric "pure" CeO_2 is σ_{oe} and $(1 - \bar{\xi}a)$ is a correction for CaO doping. The quantity, $\bar{\xi}$, is related to a geometrical blocking factor associated with the site fraction of Ca^{+2} ions on normal Ce^{+4} ion sites, a. The second term in the above expression for σ represents the ionic conductivity, which is proportional to the oxygen vacancy concentration and mole % CaO. (auth)

950 (COO–1441-15) STUDY OF THE DEFECT STRUCTURE OF NONSTOICHIOMETRIC CeO_2. Technical Progress Report. Blumenthal, Robert N. (Marquette Univ., Milwaukee, Wis. Coll. of Engineering). Sep 1971. Contract AT(11-1)-1441. 22p. Dep. NTIS.

The electrical conductivity of sintered specimens of nonstoichiometric $Ce_{1+y}O_2$ was measured as a function of temperature from 1000 to 300°C and composition from $0.00214 \leq y \leq 0.0977$. These results were described in terms of a high- and low-temperature region. Each temperature region was characterized by an exponential dependence on temperature. The temperature of the intersection between the high- and low-temperature regions for each composition was compared with the composition–temperature dependence of the miscibility gap reported by Brauer and Gingerich. The temperature dependence in the high-temperature region was attributed to a change in both the carrier concentration and carrier mobility. An approximate value of the standard enthalpy of formation for the defect reaction $Ce_{Ce} + Ce_i \cdots = Ce_i \cdots\cdot + Ce'_{Ce}$; $\Delta H \simeq 1.6$ eV was determined from the temperature dependence of the conductivity in this study and from the temperature dependence of the electron mobility reported in the literature. The electrical conductivity of sintered specimens of CaO-doped CeO_2 (0.1 to 7.0 mole %) was also measured over the temperature range 700 to 1500°C and from 1 to 10^{-22} atm of oxygen. All specimens of CaO-doped CeO_2 exhibited mixed conduction. The electrical conductivity was rationalized in terms of a defect model involving nonstoichiometric defects (ionized cerium interstitials and localized electrons) and impurity-generated defects (doubly ionized oxygen vacancies). Good agreement was obtained between the theoretically derived relation based on this defect model: $\sigma = \sigma_{oe}(1 - \bar{\xi}a) + A(\%CaO)\exp(-E_i/kT)$ and the electrical conductivity data; where σ_{oe} is the electronic conductivity of nonstoichiometric "pure" CeO_2 and $(1 - \bar{\xi}a)$ is a correction for CaO doping. The second term in the expression for σ represents the ionic conductivity, which is proportional to the oxygen vacancy concentration and mole % CaO. The diffusion coefficient for oxygen vacancies, in CaO-doped Ce_{1+} O_2 was also determined from the conductivity study: $Dv_i' = 1.4 \times 10^{-1}$ (kT)exp (−.61/kT). Ionic transference measurements employing an emf

technique were also made on a 5 mole % CaO-doped $Ce_{1+y}O_2$ specimen as a function of temperature (710 to 1008°C) and oxygen pressure ($1 - 10^{-22}$ atm). The thermogravimetric measuring system was modified to work in a partial vacuum. Departures from stoichiometry as low as $y \sim 2 \times 10^{-4}$ may now be measured with this system. At lower temperatures (800 to 1000°C) near stoichiometry (i.e., $3.5 < y < 3.0$) the following simple isothermal relationship between y and P_{O_2} was observed: $y = K P_{O_2}^{1/6}$. $\Delta\bar{H}_{O_2}$ was also shown to be independent of y in this region. (auth)

951 (DP-MS-71-46) MAGNETIC PROPERTIES OF SOME ACTINIDE HALIDE COMPOUNDS. Hendricks, M. Elton (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jul 1971. 195p. Dep. NTIS.

Thesis. Submitted to Univ. of South Carolina, Columbia.

Magnetic susceptibility measurements on 13 actinide compounds were made with a vibrating-sample magnetometer, mostly in the temperature range 2.5 to 70°K at 10,000 Oe. These compounds were: Cs_2NaMCl_6 where M is a trivalent actinide, U, Np, Pu, Am, Cm, Bk, the latter two doped into $Cs_2NaLuCl_6$; UCl_3; $NpCl_3$; $PuCl_3$; $PaCl_4$; UCl_4; PuF_4; and UBr_4. Theoretical calculations, including intermediate coupling and limited J-mixing, were performed for several cases for comparison with experimental magnetic properties. Results for the octahedral compounds include determination of ground levels, observation of small distortion effects, and measurement of limits on crystal-field parameters. In the Cs_2NaMCl_6 matrix, the following ground levels were determined: U^{3+}, Γ_8; Np^{3+}, Γ_5; Pu^{3+}, Γ_8; Am^{3+}, Γ_1; Bk^{3+}, Γ_1. The U, Np, and Pu compounds, at the lowest temperatures, gave deviations from Curie–Weiss behavior that are attributed to small distortions from octahedral symmetry. Crystal-field calculations, including J-mixing with the first-excited state, were made for U^{3+} and Np^{3+} for ratios of the octahedral crystal-field parameters, B_0^6/B_0^4, between 0 and +1, varying B_0^4 from 0 to +20,000 cm^{-1}. Assuming an approximately constant B_0^6/B_0^4 ratio in the Cs_2NaMCl_6 series, the limits $+0.07 \leq (B_0^6/B_0^4) \leq +0.77$ were established from analysis of U^{3+} and Np^{3+} data. $Cs_2NaAmCl_6$ below 70°K exhibits temperature-independent paramagnetism in good agreement with the theoretical value. Bk^{3+} in $Cs_2NaLuCl_6$ also gives temperature-independent paramagnetism. Antiferromagnetic ordering was found for UCl_3, $T_N = 22 \pm 1$°K, and for $PuCl_3$, $T_N = 4.5 \pm 1$°K. $NpCl_3$ exhibited temperature-independent paramagnetism below 50°K. Each of the C_{3h} compounds displays Curie–Weiss behavior at relatively low temperatures, with measured moments in close agreement with the free-ion values. Using previously reported wave functions and energy levels for $PuCl_3$, calculated and experimental susceptibilities were in excellent agreement from 10 to 500°K. $PaCl_4$ was found to have a ferromagnetic transition, with $T_C = 182 \pm 2$°K, an unusually high transition temperature for a ferromagnetic insulator. Below 182°K, the magnetization was unsaturated at fields up to 12,000 Oe; hysteresis was not observed above 3.29°K. In the paramagnetic region, $PaCl_4$ obeys the Curie–Weiss law from 182 to 210°K; crystal-field calculations for this region indicate that J-mixing is significant. UCl_4 has a magnetic moment with complex behavior below 190°K, with temperature-independent paramagnetism below 35°K; the susceptibility in this region was reproduced by a simple theoretical model. The magnetic behavior of both PuF_4 and UBr_4 is consistent with low-symmetry crystal fields. PuF_4 showed temperature-independent paramagnetism below 70°K, indicating a fairly large crystal field. UBr_4 was paramagnetic at the lowest temperatures measured, consistent with a small C_{2v} crystal field. Freshly prepared PuF_4 below 15°K gave an anomalously large, temperature-dependent diamagnetism, which disappeared upon aging. (auth)

952 (JUL-750-FF) TRANSPORT PROPERTIES OF DILUTE MAGNETIC ALLOYS IN MAGNETIC FIELDS. Bohnen, Klaus-Peter (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Apr 1971. 74p. (In German). Dep. NTIS (U. S. Sales Only).

The scattering of electrons on magnetic defects is theoretically treated. Transport theory, a model, the Boltzmann equation and its solution with one relaxation time, and calculation of relaxation time are discussed. Magnetoresistance in Born's first approximation is subsequently treated. Then, the discussion centers on the scattering of conduction electrons according to the transport equation in a static magnetic field. Results of the theoretical analysis have validity for the combination of either high temperatures and random magnetic fields or for strong magnetic fields and random temperatures because, for the two cases, defect calculations converge. (H.B.G.)

953 (UJV-2524-F) STUDY OF THE DYNAMICS OF THE CRYSTAL LATTICE OF NbC AND TaC PHASES BY THE METHOD OF TWO TEMPERATURES. Krivy, I. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 65p. (In Czech). INIS.

The Debye temperatures of interstitial MC_{1-x} solid solutions (M = Nb or Ta) were studied by the method of two temperatures, using temperatures of 110 and 300°K. In the temperature range studied, the mean square atomic displacements from equilibrium position did not depend on the size and orientation of the diffraction vector. This proved isotropy of the NbC and TaC phases with respect to thermal lattice vibrations at these temperatures. Various approximations used for the temperature dependence of the Debye parameter Θ yielded almost identical results for the reference temperature of 300°K. The Θ values of the TaC_{1-x} interstitial solutions did not depend on composition in the concentration range of $0.02 < x < 0.11$. For 300°K, the following values were obtained, related to virtually stoichiometric composition ($x = 0.02$): $\Theta_{NbC} = 643 \pm 18$°K, $\Theta_{TaC} = 430 \pm 21$°K. The vibration amplitudes for Nb and Ta were smaller than for carbon and the difference $\langle U_C^2 \rangle^{1/2} - \langle U_M^2 \rangle^{1/2}$ decreased with increasing temperature. A separation of temperature factors of both components resulted in the following Θ values for 300°K: $\Theta_{NbC} = 654$°K, $\Theta_{TaC} = 420$°K. The thermal expansion factor of the solid solutions was $\alpha_{110(NbC)}^{300} = (5.6 \pm 0.6) \times 10^{-6}$ deg^{-1} and $\alpha_{110(TaC)}^{300} = (4.5 \pm 0.6) \times 10^{-6}$ deg^{-1}. (INIS)

954 (Y-DA-4246) LEE-AES-EID STUDIES OF LITHIUM HYDRIDE. Clausing, R. E.; Powell, G. L.; Holcombe, C. E. Jr. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). [1970]. Contract W-7405-eng-26. 14p. (CONF-711018-1). Dep. NTIS.

From fifty-third metals show and materials engineering congress; Detroit, Mich. (18 Oct 1971).

A study of the (100) surface of LiH was made using low-energy diffraction, Auger emission spectroscopy, and electron-induced emission. The results are explained by postulating a surface excess of Li epitaxially fixed to the LiH substrate. The ratio of H-to-Li probably varied from ~0 at the surface to near unity a few atomic layers below. The surface structure is determined by the balance between the steady-state thermal desorption of Li and H from the first monolayer and the diffusion of hydride ions and H through the surface concentration gradient. (D.L.C.)

955 THORIUM MONOSULFIDE: HEAT CAPACITY AND THERMODYNAMIC PROPERTIES FROM 1 TO 350°K. RE-EVALUATION OF THE MAGNETIC ENTROPY OF URANIUM MONOSULFIDE. Flotow, Howard E.; Osborne, Darrell W.; Walters, Robert R. (Argonne National Lab., Ill.). J. Chem. Phys.; 55: No. 2, 880 6(15 Jul 1971).

The heat capacity of thorium monosulfide was determined between 1 and 22°K by an isoperibol method and between 8 and 350°K by an adiabatic method. Below 4.2°K the heat capacity is represented by $C_P = 3.70 \times 10^{-3}T + 3.98 \times 10^{-4}T^3$ J °K^{-1} · $mole^{-1}$, where the first term is the conduction-electron contribution and the second term the lattice contribution to the heat capacity. Values for the thermodynamic quantities C_P^0, S^0, $(H^0 - H_0^0)/T$, and $(G^0 - H_0^0)/T$, at 298.15°K are 47.72 ± 0.24, 69.81 ± 0.35, 32.60 ± 0.16, and −37.21 ± 0.19 J°K^{-1} · $mole^{-1}$, respectively. The entropy of formation at 298.15°K is −15.46 ± 0.47 J°K^{-1} · $mole^{-1}$, and an estimated value for the Gibbs energy of formation at 298.15°K is −430 kJ $mole^{-1}$. The magnetic entropy of uranium monosulfide associated with the ferromagnetic transition at 180.1°K was previously estimated as 6.8 J°K^{-1} · $mole^{-1}$ but has been re-evaluated as 8.8 ± 0.4 J°K^{-1} · $mole^{-1}$. The re-evaluation was based upon a new estimate of the lattice heat capacity of uranium monosulfide from the heat capacity of thorium monosulfide and a corresponding-states calculation. These calculations also lead to the conclusion that the coefficient γ in the conduction-electron contribution to the heat capacity of uranium monosulfide above the ferromagnetic transition is only 59% of the value near 0°K. (auth)

956 INFRARED SPECTRA OF V_2O_5 SINGLE CRYSTALS. Hevesi, I.; Abdullaev, A. A.; Lebedev, V. S. (Inst. of Crystallography, Moscow). Sov. Phys.-Cryst. (Engl. Transl.); 16: No. 2, 275-8(Sep-Oct 1971).

Translated from Kristallografiya; 16: No. 2, 334-8(Mar-Apr 1971).

The transmission spectra of thin single-crystal V_2O_5 films in polarized light were obtained in the region 0.4 to 25 μ. The values of the optical characteristics in this region were made more precise. Several new weak bands connected with the nonstoichiometry and with the presence of impurities in the crystal structure were detected. (auth)

957 MAGNETIC PROPERTIES OF $Sm_{1-x}Pr_xCo_5$ COMPOUNDS. Shibata, Tsugio; Katayama, Toshikazu; Mizuhara, Takeshi (Electrotechnical Lab., Tokyo). Jap. J. Appl. Phys.; 10: No. 10, 1479-80(Oct 1971).

Lattice parameters, anisotropic field strength, and magnetic properties (saturation magnetization, crystalline anisotropy, coercive force, remanence, and maximum energy product) were measured over the entire composition range for the series

$Sm_{1-x}Pr_xCo_5$. The properties all have a critical point at x = 0.5, indicating that $Sm_{0.5}Pr_{0.5}Co_5$ is a better permanent magnet material than $SmCo_5$ or $PrCo_5$. (D.L.C.)

958 ELECTRIC CONDUCTION AND STRUCTURE DEFECTS IN HIGH TEMPERATURE ThO_2. I. EXPERIMENTAL STUDY OF THE TOTAL ELECTRICAL CONDUCTIVITY OF SINTERED ThO_2. Hammou, A.; Deportes, C. H.; Robert, G. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). J. Chim. Phys.; 68: No. 7, 1162-9(Jul 1971). (In French).

The electrical conductivity of very compact (nearly 99%) sintered ThO_2 was measured as a function of temperature (1000–1500°C) and oxygen partial pressure ($1-10^{-20}$ atm). Pure ThO_2 powder was prepared by the thermal decomposition of precipitated thorium oxalate. The values of the conductivities are not affected by the different sintering conditions (atmosphere, temperature). The results obtained are compared with the data from the literature. They confirm the mixed ionic and electronic character of the electrical conduction in ThO_2. (France)

959 ELECTROCHEMICAL INVESTIGATION OF PARTIAL CONDUCTIVITY, TRANSPORT, AND CONCENTRATION OF ELECTRONS AND DEFECT ELECTRONS IN DOPED ZIRCONIUM DIOXIDE AND THORIUM DIOXIDE. Burke, L. D. (University Coll., Cork, Ireland); Rickert, H.; Steiner, R. Z. Phys. Chem. (Frankfurt); 74: No. 3-6, 146-67(May 1971). (In German).

Zirconium dioxide and thorium dioxide were doped with a few percent of either CaO, MgO, or Y_2O_3. Stationary polarization measurements as well as nonstationary measurements on the solid electrolytes were studied theoretically and experimentally. The nonstationary measurements yielded not only partial conductivity but also mobility and concentration of quasi-free electrons and defect electrons. The measurements verified the defect models reported in the literature. For doped ZrO_2, nonstationary measurements yielded a mobility of quasi-free electrons in an order of magnitude of 10^{-2} cm^2/V sec at a temperature of 1000°C. (H.B.G.)

960 NEUTRON DIFFRACTION AND MAGNETIC STRUCTURES OF RARE EARTH ELEMENTS AND OF 3d–4f INTERMETALLIC COMPOUNDS. Will, G. (Univ., Bonn). Z. Angew. Phys.; 32: No. 1, 1-8(1971). (In German).

Neutron-diffraction experiments and the magnetic structures of the rare earth elements, rare earth alloys, and intermetallic compounds between rare earth and 3d elements are reported. The theory of the magnetism of the rare earth elements allows one today to understand the magnetic structures and their complicated temperature dependence. Three mechanisms have to be considered: (1) a long-range Heisenberg-type interaction between the localized 4f-electrons through polarization of the conduction electrons (RKKY interaction), (2) the influence of the magnetic anisotropy through the crystal field, and (3) magnetostrictions. The influence of an outside magnetic field and of pressure on the magnetic structures is discussed. Binary compounds have gained an ever-increasing interest since the discoveries of YCo_5 and $SmCo_5$. Results are reported of a neutron-diffraction study on ferromagnetic $ErFe_2$, which has a Neel temperature of T_N = 600°K and a compensation point at 410°K. The very different temperature dependence of the sublattice magnetization of Er and Fe explains the strange magnetic behavior of this compound. (auth)

961 MAGNETIC DOMAINS AND MAGNETIZATION PROCESS IN SMALL RCo_5 PARTICLES. Bachmann, K.; Hofer, F. (Brown Boveri Forschungszentrum, Baden, Switzerland). Z. Angew. Phys.; 32: No. 1, 41-4(1971). (In German).

In order to investigate the magnetization process in hard-magnetic RCo_5 compounds (where R = Y, Ce, Pr, and Sm), their magnetic domain structures were studied. The domains on small (10 to 100 μm) RCo_5 particles were revealed using the Kerr technique. The observed domain structure is typical for a hexagonal material showing high crystalline anisotropy and having its direction of easy magnetization parallel to the c-axis. Even demagnetized particles of 10 μm consist of a few domains. The demagnetization process of an initially fully magnetized particle thus proceeds by nucleation and subsequent growth of domains of reversed magnetization. The nucleation and growth of reverse domains in RCo_5 particles were observed. (auth)

962 DEGENERATE EXCITED STATE IN THE STRUCTURE OF B_2O_3. Leidecker, H. W.; Simmons, J. H.; Litovitz, T. A.; Macedo, P. B. (Catholic Univ. of America, Washington, D. C.). J. Chem. Phys.; 55: No. 5, 2028 31(1 Sep 1971).

A degenerate excited state is essential to the description of structural rearrangements that account for the relaxational heat capacity, thermal expansion, and compressibility of vitreous B_2O_3. These relaxational responses cannot be simultaneously described by a two-state model, or by any model involving a single ordering parameter, as shown by the magnitude of the Prigogine–Defay ratio ($\pi \neq 1$). The apparent two-state behavior of the temperature derivatives, $\Delta\alpha$ and Δc_p, and failure of a two-state model to predict a sufficiently large compressibility (pressure derivative), suggest an analysis of structural rearrangements in vitreous B_2O_3 in terms of a single ground state and a twofold degenerate excited state characterized by different volumes. (auth)

963 MINORITY CARRIERS IN GRAPHITE. Woollam, John A. (Lewis Research Center, Cleveland). Phys. Rev., B; 4: No. 10, 3393-8(15 Nov 1971).

Quantum oscillations as a function of magnetic field in the Hall effect and thermoelectric power are studied in two samples of pressure-annealed pyrolytic graphite. Only the oscillations originating from minority–Fermi-surface carriers are discussed. de Haas–van Alphen-type frequencies are measured over a wide range of angles between the magnetic field and the c axis of the Brillouin zone. The major conclusions are as follows: (i) There are at least two minority carriers in graphite; (ii) pyrolytic and natural single crystals have the same minority–Fermi-surface sections; (iii) both minority carriers observed by quantum effects very likely originate from the corners of the Brillouin zone near the H points; and (iv) under the assumption that $\gamma_0 = 3.18$ eV, it is estimated that $\Delta = +0.004$ eV. (auth)

964 MAGNETIC SUSCEPTIBILITY OF HIGH-PURITY THORIUM. Greiner, J. D.; Smith, J. F. (Iowa State Univ., Ames). Phys. Rev., B; 4: No. 10, 3275-7(15 Nov 1971).

The magnetic susceptibility of thorium was measured between 18 and 328°K. The thorium samples were refined by the electrotransport process and had electrical resistivity ratios ranging between 790 and 1300. Linear extrapolation of the data to 0°K yields a value of $+0.383 \times 10^{-6}$ emu/g. This susceptibility increases nearly linearly with increasing temperature to $(+0.412 \pm 0.001) \times 10^{-6}$ emu/g at 300°K. This behavior is qualitatively consistent with the behavior of a number of other physical properties and implies a temperature-dependent electronic distribution in thorium metal. (auth)

965 TEMPERATURE DEPENDENCE OF THE HALL EFFECT AND PARAMAGNETIC SUSCEPTIBILITY OF PALLADIUM–TANTALUM, AND SCANDIUM–HAFNIUM ALLOYS. Prudnikov, V. N.; Volkov, D. I.; Kozlova, T. M. (Moscow State Univ.). Fiz. Metal. Metalloved.; 30: No. 1, 31-7(Jul 1970). (In Russian).

The temperature dependence of the Hall effect, magnetic susceptibility, and electrical resistance of Pd–Ta and Sc–Hf alloys of a wide range of compositions was studied at 77 to 300°K. In Sc and Hf, the Hall field and magnetic susceptibility varied as the square of the temperature. In the Pd–Ta alloys, the effective Hall constant and the magnetic susceptibility varied in accordance with the standard $1/(T - T_0)$ law, while in the Sc–Hf alloys, the corresponding relationships were much more complex. For all the alloys, the Hall constant varied linearly with the magnetic susceptibility, and the electrical resistance varied linearly with temperature. (Metals Abstr.)

966 MAGNETIC ORDER IN METALS OF THE CERIUM SUBGROUP IN THE RARE-EARTH SERIES. Kazakov, A. A. (Ural State Univ., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 30: No. 1, 202-3(Jul 1970). (In Russian).

Magnetic-ordering effects in metals of the Ce subgroup of the rare-earth series (Ce, Pr, Nd, Pm, and Sm) were studied and compared with existing data relating to the Y subgroup. The results were also compared with theoretical formulas relating the critical (Néel) temperature to the atomic numbers of the corresponding metals. The observed critical temperatures for Ce, Pr, Nd, and Sm were 11.4, 28.8, 40.0, and 25.9°K; these agreed qualitatively with theory, except for Nd. (Metals Abstr.)

967 WORK FUNCTION AND LEED STUDY OF Na AND O_2 COVERED SURFACES OF W(112). Chen, J. M.; Papageorgopoulos, C. A. (Franklin Inst., Swarthmore, Pa.). Surface Sci.; 26: No. 2, 499-508(Jul 1971).

Coadsorption of Na and O on W(112) surfaces was studied with LEED and work function measurement. The composition and sequence of deposition of the adsorbates have been varied systematically. The results suggest that Na and O form a W–O–Na double layer, regardless of the sequence of deposition. It is found that the underlying O layer causes increased interaction among the Na atoms which improves the long-range order of the Na array. An expansion of the Na layer due to O adsorption has been observed. (auth)

968 COMPUTATIONS OF RELATIVISTIC LEED INTENSITIES AND SPIN-POLARISATIONS FOR TUNGSTEN(001). Jennings, P. J. (Flinders Univ., Bedford Park, Australia). Surface Sci.; 26: No. 2, 509-21(Jul 1971).

The effects of relativistic corrections in low-energy electron-diffraction intensity calculations are assessed by reference to

relativistic and nonrelativistic computations for tungsten (001). Small changes are observed in the calculated intensities and band structures and a significant degree of spin polarization is predicted for the diffracted beams. The spin polarization profiles are more complicated than those observed in gas-phase experiments because of the influence of multiple scattering. The results suggest that LEED could provide a strong source of polarized electrons for use in scattering experiments. It is suggested that in future LEED experiments, both spin polarization and intensity measurements should be performed on the diffracted electron beams. (auth)

969 THERMIONIC EMISSION FROM SINGLE-CRYSTAL FILAMENTS. Gardner, F. M.; Girouard, F. E.; Boeck, W. L.; Coomes, E. A. (Univ. of Notre Dame, Ind.). Surface Sci.; 26: No. 2, 605-23(Jul 1971).

A thermionic projection diode with an aluminized fluorescent screen was used to determine the average and point-by-point Richardson constants for the [110] zone of W and Mo filamentary single crystals. Errors due to secondary emission of electrons at the anode were corrected by data collected in a separate experiment. An apparent functional relationship between measured values of ϕ_R^* and A_R^* is discussed in terms of a patch theory which departs from previous patch theories by the introduction of the fundamental patch. In terms of this theory, micropatches are composed of fundamental patches, and the micropatch distribution on an emitter determines the compensation between the Richardson constants. For filamentary single crystals of W and Mo, a Gaussian distribution of micropatches was found to establish the observed compensation between ϕ_R^* and A_R^*. The Gaussian micropatch distributions are centered on the work function of a fictitious apparent patch and the width of the Gaussian increases with atomic roughness of the emitting surfaces. The suggestion is made that the micropatch effect may be the dominant factor in the point-by-point variation in emission constants measured over a filamentary single crystal. (auth)

970 SILICON ADSORPTION ON TUNGSTEN FIELD EMITTERS. Collins, R. A. (Univ. of Lancaster, Eng.). Surface Sci.; 26: No. 2, 624-36(Jul 1971).

The adsorption properties of silicon on tungsten are found to be markedly different to those observed for Ge and CdS. The Fowler–Nordheim parameters ϕ and A vary with silicon coverage in a manner qualitatively similar to that observed during metallic adsorption. The field-emission work function of "monolayer" films of Si deposited at 295°K was found to be 4.72 ± 0.05 eV. The thermal-desorption activation energy for the coverage range $0.1 < \theta < 0.3$ was determined as 3.82 eV/atom. The surface-diffusion kinetics of silicon on tungsten have been qualitatively observed. Deposition at 1250°K results in localized growth around the (100) planes, single-crystal growth being evident for average coverages >2 monolayers. It is considered that the growth of large Si single crystals on W substrates should be feasible and that these crystals could be utilized as Si field-emission substrates for adsorption studies of metals on Si. (auth)

971 SURFACE IONIZATION HYSTERESIS PHENOMENA. Wilson, R. G. (Hughes Research Labs., Malibu, Calif.). Surface Sci.; 25: No. 2, 385-93(Apr 1971).

A detailed study of hysteresis phenomena in the surface ionization of cesium on polycrystalline metals revealed a variety of reproducible effects and influences. Fine structure in the adsorption phase of temperature hysteresis on molybdenum, including multiple transition temperatures, was observed and is attributed to the polycrystallinity of the substrate. The influence of increasing cesium arrival flux (ion current density) is to decrease the magnitude of the temperature hysteresis until it disappears in the range from 10^{-4} to 10^{-1} A/cm^2, varying with substrate. The time rate of change of temperature through the hysteresis region was shown to influence the magnitude of the temperature hysteresis, increasing rates causing increasingly larger apparent temperature hysteresis. A new phenomenon, an applied field hysteresis, was observed in the region of temperature hysteresis for several substrates and a hysteresis loop spanning 1.5 orders of magnitude in ion current between 200 and 500 V/cm applied field is shown for a copper substrate. Hysteresis effects were observed only for adsorbates with ionization potential less than the substrate work function. (auth)

972 EFFECT OF OXYGEN ON THE TEMPERATURE DEPENDENCE OF ELECTRICAL PROPERTIES OF REACTIVELY SPUTTERED TANTALUM FILMS. Waterhouse, Neil; Westwood, William D. (Bell-Northern Research, Ottawa). Can. J. Phys.; 49: No. 17, 2250-63(1 Sep 1971).

The negative temperature coefficient of resistivity (TCR) displayed by β-Ta, which has thus far not been satisfactorily explained, was examined by measuring the variation of electrical resistivity with temperature, from ~20 to 300°K, and by measuring the Hall coefficients, at room temperature and at 77°K, of films containing up to ~60 at.% oxygen. The Hall measurements indicate carrier concentrations of $\sim 10^{22}$ cm^{-3} and mobilities of ~1 cm^2/Vsec. The analysis of the results considered the granular structure of the films and, subsequently, these results were compared with an "activated tunneling" model of conduction. Theoretical calculations that assume the film to be comprised of cubic grains separated by Ta_2O_5 agree well with the experimental measurements. Metallic conduction still appears to be contributing to the film properties even at the highest oxygen concentrations of the present investigation. (auth)

973 ELECTRICAL PROPERTIES OF MOLYBDENUM-DOPED ZIRCONIUM MONOCARBIDE. Neshpor, V. S.; Nikitin, V. P.; Ordan'yan, S. S.; Skaletskaya, N. A. (Leningrad Tech. Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 529-31 (Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 606-9(Apr 1971).

The cross section $ZrC_{0.96}$–Mo of the system Zr–C–Mo has a quasi-binary character. The appearance of a molybdenum phase is noted by x-ray analysis at ~3 at.% Mo, but the electrical resistance shows that the solubility of molybdenum in $ZrC_{0.96}$ is ~1 at.%. With increasing Mo content in the homogeneity region, a decrease of the absolute value of the negative Hall coefficient and an extremal concentration dependence of the resistivity are observed, with a minimum at 0.3 at.% Mo. The observed dependences may be explained by an increase in the density of states of the collectivized electrons in the region of the Fermi level. The absolute differential thermo-emf of $ZrC_{0.96}$–Mo alloys has a negative sign and its absolute value decreases only near the lower boundary of the homogeneous region. This decrease is due to a simultaneous increase of the current carrier concentration in the alloys and of their effective mass. (D.L.C.)

974 ELECTRICAL PROPERTIES OF ALLOYS IN THE SYSTEM ZrC–Mo_3C_2. Grebenkina, V. G. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 4, 608-9(Apr 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 4, 701-2(Apr 1971).

The temperature dependence of the electric resistance of ZrC–Mo_3C_2 mixtures was measured between 20 and 1000°C. The resistance increases linearly with temperature, indicating metallic-type conductivity. The resistance increases smoothly with Mo_3C_2 concentration up to 40 mole %. The Hall constant was also measured and formed to change sign from negative to positive at ~4 mole % Mo_3C_2, reaching a maximum positive value at 40 mole % Mo_3C_2. (D.L.C.)

975 ELECTRICAL CONDUCTIVITIES OF TRANSITION-METAL NITRIDES IN THE INTERVAL 77 TO 300°K. Shvedova, L. K. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 3, 455-6(Mar 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 3, 517-18(Mar 1971).

The temperature dependence of the electric resistivity and thermo-emf of sintered $TiN_{0.84}$, $ZrN_{0.92}$, HfN, $VN_{0.91}$, $NbN_{0.75}$, and TaN was measured at 77 to 300°K. The nitrides display metallic-type conductivity, the resistances of nitrides of group IV metals being less than those of group V metals. For all the nitrides, the thermal coefficient of the resistance is positive, the absolute thermo-emf is negative, and its temperature dependence is virtually linear. (D.L.C.)

976 ELECTRON GAS MODEL FOR THE LATTICE DYNAMICS OF LANTHANIDES. Kushwaha, S. S.; Kumar, A. (Banaras Hindu Univ., India). J. Phys., C (London); 4: No. 13, 1674-9(17 Sep 1971).

The dynamical matrix is split into ionic and electronic parts. Ionic elements of the matrix were obtained considering purely central forces up to the fourth neighbor and the electronic elements were derived following Bhatia's work on cubic metals. Phonon dispersion relations and the lattice specific heats were computed for gadolinium and dysprosium. Lattice specific heats were compared with the experimental data. (auth) (UK)

Moessbauer Effects and NMR

Refer also to abstract 340.

977 NUCLEAR MAGNETIC RESONANCE DETERMINATION OF THE ISOTOPE EFFECT IN TITANIUM TRITIDE. Weaver, H. T. (Sandia Labs., Albuquerque, N. Mex.). Phys. Lett.; 35A: No. 6, 417-18(12 Jul 1971).

Nuclear magnetic resonance methods have been used to observe

an isotope effect for hydrogen diffusion in $TiH_{1.5}$. The observed mass dependence of the atomic jump frequency and activation energy is consistent with the analysis of LaClaire. (auth)

978 OBSERVATION OF THE INTERFERENCE BETWEEN PHOTOEFFECT AND INTERNAL CONVERSION WITH THE 21-keV M1 MOESSBAUER TRANSITION OF ^{151}Eu. Steiner, P.; Weyer, G. (Freie Univ., Berlin). Phys. Lett.; 36A: No. 3, 201-2(30 Aug 1971).

The interference of the photoeffect and nuclear resonance absorption followed by internal conversion has been observed for the 21-MeV M1 transition in ^{151}Eu. The measured interference parameter is $\beta_{M1}^{exp} = (0.92 \pm 0.18) \times 10^{-2}$. (auth)

Theory

Refer also to abstract 987.

979 DENSITY FUNCTIONAL IN LOCALLY LINEAR POTENTIAL APPROXIMATION. Baltin, R. (Technische Univ., Brunswick). Phys. Lett.; 37A: No. 1, 67-8(25 Oct 1971).

The kinetic energy density functional of electrons moving in a common effective one-body potential is calculated in a locally linear potential approximation and given in terms of electron density ρ and $y \equiv |\Delta\rho|^{\frac{1}{3}} \rho^{-\frac{1}{3}}$ for all ρ and y. The limits $y \to 0$ and $y \to \infty$ are discussed. (auth)

Theoretical Physics

Refer also to abstracts 32, 1004, and 1085.

980 (KFK-tr-374) BACKGROUND SUBTRACTION BY PARAMETER EVALUATION ACCORDING TO THE MAXIMUM LIKELIHOOD METHOD. Kurbatov, V. S.; Tyapkin, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, Ger.), from report JINR-P1-5234. 19p. (In German). Dep. NTIS (U. S. Sales Only).

Treated is the experimental determination of theoretically assessed parameters according to the maximum likelihood method. Taking into consideration background measurements, the most general method is optimized for the case in which, during the analysis, the total experimentally obtained information is utilized within the coordinates of single events. The error matrix of parameters is formulated. The proposed method does not presume any special distribution function of background events. It takes into account only the information that is obtained by means of a separate background experiment. (tr-auth)

981 (UCID-15832) A NEW APPROACH TO CALCULATING EMP. I. TRANSFORM METHOD BY COMPUTER FOR RETARDED SOLUTION OF WAVE EQUATION. Nishimura, K.; Schneider, S.; Spitzer, R. (California Univ., Livermore. Lawrence Radiation Lab.). Apr 1971. 52p. Dep. NTIS.

A new approach to the numerical calculation of the time-dependent electromagnetic pulse from a nuclear burst is described. The method consists of Fourier transforming the space- and time-dependent differential equations, solving the algebraic (or quasi-algebraic) transformed equations, and finally calculating the solution in space-time by inverting the transform. Treatment of the partial differential equation by finite differencing is completely avoided. The numerical work involves only integrations. Two central difficulties in the program to solve the partial differential equations numerically by this method are posed and solved. 1) the incorporation of retarded temporal effects in the computational procedure, and 2) numerical treatment of the singular integrands. The technique by which this is accomplished is independent of the detailed structure of the wave operator; it can therefore readily handle wave phenomena in dispersive, absorbing, stratified media, with even nonlinear field-dependent corrections. The scalar wave equation with a prescribed source is considered as a test problem. The retarded solution is found numerically by the transform method and compared with the analytic one. The two solutions are in good agreement. (auth)

982 CALCULATION OF THE INCOHERENT SCATTERING CROSS SECTION $S_s(k,w)$ IN NON GAUSSIAN APPROXIMATION FOR CLASSICAL LIQUIDS. Baijal, J. S.; Chaturvedi, D. K. (Univ. of Delhi). J. Phys. Soc. Jap.; 31: No. 2, 431-5(Aug 197').

The self correlation function $G_s(r,t)$ and its space-time transform $S_s(k,w)$ are calculated in the non-Gaussian approximation by using a model for a liquid in which molecules move by Langevin diffusion between random binary collisions and also taking the solid-like oscillatory behavior into account according to the model of Rahman, Singwi, and Sjölander. Similar calculations for $G_s(r,t)$ in the non-Gaussian approximation were previously done by Gibbs and Ferziger. But in their model these authors did not incorporate the oscillatory motion characteristic of liquids. Hence, the present model shows an improvement over GF. The non-Gaussian corrections were estimated for liquid argon by comparing the best fit of the calculated $S_s(k,w)$ for different values of $\alpha/(\alpha+\beta)$ with the computer experimental non-Gaussian $S_s(k,w)$ of Nijboer and Rahman at $K = 2\text{Å}^{-1}$. Here α and β are the binary collision rate and the Langevin friction coefficients, respectively. From the results it appears that in liquid argon (to the extent that it is described by the present model) the binary collision rate is about four times the Langevin friction coefficient. (auth)

983 CONDUCTIVE TRANSFER IN RELATIVISTIC MEDIUM. Suhonen, E. (Univ. of Jyvaeskylae, Finland). Ann. Acad. Sci. Fenn., Ser. A VI; No. 356, 1-23(1971).

A general-relativistic theory of energy transfer was developed in a form which is applicable both to material particles and to photons and neutrinos. Distributions of temperature and chemical potential corresponding to thermal equilibrium were derived. The transformation properties of the quantities used are considered. (auth) (Finland)

984 COMPUTER SOLUTIONS TO SOME SIMPLE ONE-DIMENSIONAL SCHROEDINGER EQUATIONS. Merrill, John R.; Hughes, Gregory P. (Dartmouth Coll., Hanover, N. H.). Amer. J. Phys.; 39: No. 11, 1391-3(Nov 1971).

The Schroedinger equation for stationary states in one dimension is easily solved numerically. The problem is especially simple if the potential V (x) is symmetric so that each eigenfunction is either of even or odd parity. The method of solution is very similar to iterative numerical solutions for F = ma mechanics problems. This note points out an interesting sequence of potentials that approximate an infinite square well but have rounded corners. Eigenfunctions and eigenvalues are reported for the sequence, and a simple program is presented. The sequence of lowest energies for these potentials demonstrates a balance between kinetic and potential energy to achieve the lowest total energy for the ground state. (auth)

985 EIGENVALUES OF ORBITAL ANGULAR MOMENTUM. Kaplan, David M. (Virginia Polytechnic Inst., Blacksburg); Wu, F. Y. Chin. J. Phys. (Taiwan); 9: No. 1, 31-3(Apr 1971).

Using only the elementary commutation relations in quantum mechanics, it is shown that the eigenvalues of $L_z = xp_y - yp_x$ are integers. (auth)

986 STRUCTURE PRESERVING QUANTISATIONS. Shankara, T. S. (National Aeronautical Lab., Bangalore, India); Srinivas, M. D. Int. J. Theor. Phys.; 4: No. 5, 395-401(Sep 1971).

Maps of functions on classical phase space to quantum operators do not preserve the algebraic structure. After locating the algebraic reasons for it, the problem of quantization is redefined and the Moyal bracket is discussed for its structure preservation. This quantization entails the inclusion of Schwartz distributions to the space of classical functions. (auth) (UK)

987 QUANTUM MODEL FOR CALCULATING THE CROSS SECTION OF AN ELECTRON PHYSICALLY TRAPPED IN AN ORGANIC GLASS. Jardin, J. P.; Kottis, P. (Centre National de la Recherche Scientifique, Paris). Compt. Rend., Ser. B; 273: No. 3, 135-8(19 Jul 1971). (In French).

The cross section for the capture of photons by an electron trapped in an organic glass is calculated, using a quantum model. (France)

988 STUDY OF THE VAINSHTEIN APPROXIMATION. Felden, Madeleine (Laboratoire de Physique, Nancy). Phys. Lett.; 37A: No. 1, 73-4(25 Oct 1971).

The divergent effect of the "peaking approximation" is considered, and a hypothesis is proposed to compensate for it. (auth)

989 MODERN PHYSICS AND QUANTUM MECHANICS. Anderson, Elmer E. Philadelphia; W. B. Saunders Company (1971). 440p. $14.50.

Four great conceptual edifices form the principal themes for the first four chapters. These are: (1) the special theory of relativity and some examples of its role in contemporary physics; (2) the quantum theory of radiation and the concept of the photon as a wave packet which can display both particle and wave properties; (3) the Bohr theory of the atom and the quantization of angular momentum; and (4) the representation of a particle by a wave packet and the development of a wave mechanics for the description of a particle's dynamical states. In Chapter 5, Schrödinger's wave mechanics is applied to one-dimensional problems. In this chapter the linear harmonic oscillator is solved by both the series and the operator methods in order to familiarize with both of these approaches. This is followed in Chapter 6 by a summary of the postulates of quantum mechanics and the development of matrix mechanics. The

angular momentum operators and their eigenfunctions are introduced in Chapter 7 where they are applied to the hydrogen atom. The complexities resulting from spin and its interactions with orbital angular momenta are treated in Chapter 8. The phenomenon of exchange degeneracy resulting from the symmetry properties of identical particles is also discussed in this chapter. In Chapter 9 some approximate methods are introduced that enable the reader to solve large classes of real problems by means of the solutions obtained for the ideal systems in earlier chapters. In Chapter 10, approximate methods are applied to some specific atomic problems, and Chapter 11 is an introduction to quantum mechanical scattering theory. (auth)

990 GROUP THEORY AND SECOND QUANTIZATION FOR NONORTHOGONAL ORBITALS. Moshinsky, M.; Seligman, T. H. (Univ. of Mexico, Mexico City). Ann. Phys. (N. Y.); 66: No. 1, 311-34(Jul 1971).

When dealing with the second-quantized picture with nonorthogonal basis, the creation and annihilation operators, which are hermitian conjugate, no longer satisfy the usual anticommutation relations. If, on the other hand, an appropriate dual basis is introduced, the usual anticommutation relations exist for the ordinary creation and the dual-annihilation operators; but these operators are no longer hermitian conjugate. Nevertheless, the dual basis approach proves very convenient as all the familiar group-theoretical procedures of the second-quantized picture can still be used, at the expense of dealing with irreducible representations of linear rather than unitary groups. In problems in which nonorthogonal single-particle states are used (e.g., in molecules), O(3) is in general not a symmetry group; thus, n-particle states can be characterized by the irreducible representations of a mathematically convenient chain of subgroups. This turns out to be the canonical chain of subgroups of the linear group giving rise to Gel'fand states. The evaluation of matrix elements of one- and two-body operators with respect to these states is discussed, and the analysis is illustrated with the simplest nontrivial example in which the number of both particles and orbital single-particle states is 3. (auth)

991 INTERFERENCE OF COHERENT AND INCOHERENT INTERACTIONS IN THE DENSITY OPERATOR EQUATION. Schwendimann, P. (Univ., Stuttgart). Lett. Nuovo Cim.; 2: No. 9, 434-6(28 Aug 1971).

Conditions under which the time evolution of an open system can be given in terms of independent coherent and incoherent interaction processes are discussed. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 1006.

Electromagnetic

992 (UCRL-20128) PHOTOPRODUCTION OF ω MESONS IN A HYDROGEN BUBBLE CHAMBER BY 3 AND 5 GeV LINEARLY POLARIZED PHOTONS. Podolsky, William Jesse (California Univ., Berkeley. Lawrence Radiation Lab.). 4 May 1971. Contract W-7405-eng-48. 165p. Dep. NTIS.

Thesis.

Photoproduction was studied at 2.8 and 4.7 GeV with a monoenergetic, linearly polarized photon beam in a hydrogen bubble chamber. Since this experiment was the first to use the backscattered-laser-beam facility at SLAC, the beam is described in some detail. At these energies the beam polarization is greater than 90%. The beam is virtually free of bremsstrahlung background, and the energy resolution (FWHM) is 0.15 GeV at $\bar{E}_\gamma$ = 2.8 GeV and 0.35 GeV at $\bar{E}_\gamma$ = 4.7 GeV. The exposure produced 92 events/μb cross section at 2.8 GeV and 151 events/μb at 4.7 GeV. A detailed study was made of the reaction $\gamma p \rightarrow \omega p$ in the channel $\gamma p \rightarrow p\pi^+\pi^-\pi^0$. Knowledge of the beam energy allowed one to obtain a clean sample of this channel, including 700 ω events with very little background. It is found that $\sigma(\gamma p \rightarrow \omega p)$ = 5.3 ± 0.5 μb at 2.8 GeV and 3.0 ± 0.3 μb at 4.7 GeV. With polarized photons one could determine nine independent parameters of the ω density matrix (compared with three parameters measured in previous experiments with unpolarized beams). A linear combination of the parameters is employed to project cross sections from natural-parity exchange (σ^N) and from unnatural-parity exchange (σ^U). For $|t| < 1.0$ GeV^2, σ^N = 2.3 ± 0.4 μb, σ^U = 2.6 ± 0.4 μb at 2.8 GeV, σ^N = 1.7 ± 0.3 μb and σ^U = 1.2 ± 0.25 μb at 4.7 GeV were found. The results agree with predictions of a hybrid model employing both diffractive ω production and one-pion exchange. Comparing ω photoproduction with our Söding-model fits for $\gamma p \rightarrow \rho^0 p$, it is found that $\sigma^N(\rho^0)/\sigma^N(\omega)$ = 7.3 ± 1.2 at 2.8 GeV and 9.3 ± 1.7 at 4.7 GeV, consistent with predictions of vector dominance (VDM) plus SU(3). However, assuming VDM and the quark model, it is found that the coupling $f_\omega^2/4\pi$ = 26 ± 6, compared with 14 ± 2.8 measured in the Orsay colliding rings. Also cross sections are reported for channels with zero, one, or more neutral particles, and for reactions with η, A_2^+, f, ρ, Δ, and $\rho\Delta$. Evidence is found for production of a neutral meson decaying into $\pi^+\pi^-$ (+neutrals), consistent with $\omega\pi^0$. The cross section for $|t| < 0.5$ GeV^2 is 1.0 ± 0.6 μb at 2.8 GeV and 1.4 ± 0.6 μb at 4.7 GeV. This meson may be the B^0 or possible ρ'^0. (auth)

993 EXPERIMENTAL TESTS OF THE VECTOR DOMINANCE MODEL IN PSEUDOSCALAR MESON PHOTOPRODUCTION. Dar, Arnon (Technion-Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.); 65: No. 1-2, 324-51(15 Jun 1971).

Experimental tests of the VMD model is pseudoscalar meson photoproduction are reviewed. The difficulties associated with the model are discussed. The so-called "failures" of the model are analyzed, and their possible origins are pointed out. Impressive evidence supporting the model is emerging. New possible tests of the model are proposed. (auth)

Weak

994 PUZZLES IN COSMIC-RAY OBSERVATIONS UNDERGROUND. Murthy, P. V. Ramana (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 2: No. 15, 805-9(9 Oct 1971).

Two puzzles in the cosmic-ray observations underground are described and discussed. One puzzle is the discrepancy in the zenith-angle distribution of muons in two experiments, and the other is that in the observation of stopping muons underground an excess of slow muons stop and decay in the apparatus over and above what one would expect from a differential of depth—intensity curve and from assumed/known interactions of muons and neutrinos. The magnitude and discrepancy in the second puzzle are considered, and arguments are presented showing that a previous model to explain it is probably implausible. (J.F.P.)

Strong (Baryon-Induced)

995 (CONF-710301-(Vol.2), pp 543-50) PRECISION NEUTRON TRANSMISSION AND ENERGY MEASUREMENT BY TIME-OF-FLIGHT. Simmons, D. F.; Cramer, D. S.; Cranberg, L. (Virginia Univ., Charlottesville. Dept. of Physics).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A value for σ_{ap}^0 of 5.956 b ± 0.24% has been determined at a mean neutron energy of 526.0 ± 1.3 keV, corresponding to a singlet effective range of 2.95 ± 0.12 fermis. Time-of-flight technique made possible the achievement of high signal-background ratio and high count rate in the determination of the value of the sample transmission, with a small correction for in-scattering. Time-of-flight techniques were also used to determine the mean neutron energy. (auth)

996 (FRNC-TH-55) SEARCH FOR A RESONANCE EFFECT IN THE DIRECT CHANNEL OF THE $\bar{p}p \rightarrow K_1^0 K_1^0 \omega$ REACTION IN THE 2.02-GeV REGION. de Crespin de Billy, Lucile (Paris Univ. (France). Faculte des Sciences). 1971. 39p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The $\bar{p}p \rightarrow K_1^0 K_1^0 \omega$ channel was studied in the 1.1 to 1.44 GeV/c momentum range. The current theoretical and experimental situation concerning this problem is summarized. The contamination of a beam of antiprotons by μ mesons, the variations of the total cross section for 202 type events, and the cross section curves corresponding to the $\bar{p}p \rightarrow K_1^0 K_1^0 \pi^+\pi^-$, $\bar{p}p \rightarrow K_1^0 K_1^0 \pi^+\pi^-\pi^0$, $\bar{p}p \rightarrow K_1^0 K_1^0 \pi^+\pi^-$ reactions were studied. The variation of the cross section in the $\bar{p}p \rightarrow K_1^0 K_1^0 \omega$ channel was studied and several adjustments were made in order to establish the existence of a resonance effect in the direct channel of this reaction. The experimental results are identified with the T resonance already observed. The position of this resonance on a Regge trajectory was studied making certain hypotheses about the quantum numbers. (France)

997 (FRNC-TH-88) AN EXPERIMENT OF SCATTERING OF 3.55-GeV KAONS AND ANTIPROTONS BY PROTONS. Bonnel, Claude (Paris Univ. (France). Faculte des Sciences). [nd]. 91p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The scattering of 3.55-GeV/c kaons by protons was studied between 7 and 30 deg, and 45 and 120 deg; antiproton scattering was studied from 7 to 30 deg and 45 to 90 deg. The results obtained in three experiments together with results obtained by other workers were compared with predictions from the Regge pole model. (France)

998 (LYCEN-7141) QUASI FREE PROCESS AND PROTON-NEUTRON FINAL STATE INTERACTION IN THE d + d REACTION. Burq, J-P.; Cabrillat, J. C.; Chemarin, M.; Ille, B.; Nicolai, G. (Lyon Univ. (France). Institut de Physique Nucleaire). Jun 1971. 8p. Dep. NTIS (U. S. Sales Only).

The deuteron break-up by deuterons: d + d → d + p + n was investigated at 27.5 MeV. The three-body final state is dominated by the quasi-free process, which was studied for a target proton spectator by detecting the deuteron and the neutron in coincidence. The final state interaction (n–p) was also studied by detecting the neutron and the proton at the same angle, but the spectra showed another kinematical line corresponding to the pseudo three body reaction: d + d → (n + p) + d*, where d* is the neutron–proton system with a low-energy correlation in a S = 0, T = 1 virtual state. (France)

999 NEUTRON DIFFRACTION DISSOCIATION AND COULOMB DISSOCIATION FROM NUCLEI. Longo, M. J. (Univ. of Michigan, Ann Arbor); Jones, L. W.; O'Brien, D. D.; (and others). Phys. Lett.; 36B: No. 6, 560-2(18 Oct 1971).

Preliminary results of a spark-chamber experiment are presented on the reaction n + A → (p + π^-) + A where the (pπ^-) pair is produced coherently off the nucleus A. A 0^0 neutron beam derived from a beryllium target in the external beam of the Brookhaven proton synchrotron was used. The mean effective momentum of the neutrons was about 23 GeV/c. Forward-going (pπ^-) pairs were detected in a wire spark-chamber spectrometer, and the momentum and angle of each particle were determined. The observation of a sharp forward peak (of width appropriate to the nuclear radius) indicated that a large fraction of the events were produced coherently. Mass spectra for coherently produced events from carbon, copper, and lead targets are presented. The lead data show a peak at low masses due to Coulomb production of the $\Delta(1236)$. The most striking result of the experiment is the lack of any appreciable production of the well-established I = ½ nucleon isobars. (auth)

Strong (Meson-Induced)

1000 (FRNC-TH-74) STUDY OF CHARGED BOSON RESONANCES IN THE $\pi^- p \rightarrow p, 3\pi$ REACTION BETWEEN 940 AND 1600 MeV. Strachman, Zaharia (Paris Univ. (France). Faculte des Sciences). [1969]. 61p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A missing mass experiment performed with a 7-GeV/c π^- beam and a liquid H target was analyzed. A search for the charged boson resonances involved in the πp reaction with a recoil proton was effected. The background obtained fits perfectly the experimental spectrum in the regions $1500 \leq M_x \leq 1600$ and $900 \leq M_x \leq 960$ MeV, i.e. above A_2 and below A_1. The mass and the width of the A_2 resonance are nearly independent of the existence of the $A_{1.5}$ as the same results can be obtained with or without this resonance. The mean values obtained are: $M_{A2} = 1305 \pm 5$ MeV, $\Gamma_{A2} = 95 \pm 10$ MeV. An enhancement was obtained in the A_1 region (or $A_1 - A_{1.5}$ region) where a 0 percent Deck effect occurs. The bump rapidly decreases when the Deck effect increases, and disappears almost completely at about 70 percent. The difference between the probabilities corresponding to the two or three resonance hypothesis is not significant so that no conclusion may be drawn about the existence of this resonance. (France)

1001 (UCRL-20178) STUDIES OF TWO-PRONG INTERACTIONS IN K^+p AT 4.6 GeV/c AND π^+p AT 3.6 GeV/c. MacNaughton, Jimmy N. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1971. Contract W-7405-eng-48. 168p. Dep. NTIS.

Thesis.

Studies of two-prong interactions produced by a K^+ beam of 4.6 GeV/c and a π^+ beam of 3.6 GeV/c interacting in liquid hydrogen bubble chambers are made. Elastic scattering, single-pion production, and production of multiple neutral hadron processes were studied. In the K^+ experiment, the cross section and angular distribution of elastic scattering were measured. Single-pion production has large contributions from $\Delta(1236)$ and $K^*(890)$, whose production and decay characteristics were studied. The $K^*(1420)$ is also produced, and there is evidence of diffractive dissociation of $p \rightarrow p\pi^0$. The multiple neutral hadron events contain production of $\Delta(1236)$, $K^*(890)$ and $\eta(548)$. In the π^+ experiment the cross section and angular distribution of elastic scattering were measured. Single-pion production has large contributions from $\Delta(1238)$, ρ^+ and diffractive dissociation $p \rightarrow p\pi^0$ and $p \rightarrow n\pi^+$. Evidence is presented for interference between ρ^+ production and diffraction. Production and decay characteristics of the $\Delta(1238)$ and ρ^+, with special emphasis on the effects of other processes on the study of the ρ^+ were investigated. There is also evidence of $N^*(1688)$ production at relatively large momentum transfer. The multiple neutral hadron events contain production of $\Delta(1238)$, A_2, η, ω, $\eta'(960)$. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 1387.

General

Refer also to abstract 1356.

1002 (DESY-71/46) ARE REGGE CUTS STILL WORTHWHILE? Schrempp-Otto, B.; Schrempp, F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug 1971. 66p. Dep. NTIS (U. S. Sales Only).

In this review first the considerable internal flexibility of Regge-cut models is emphasized. In order to reduce this flexibility, popular Regge-cut models (especially Argonne, Michigan) are confronted with a set of theoretical and decisive experimental constraints, the most important ones being the dual adsorptive picture of Harari for the dip systematics and the new polarization data of πN-charge exchange. In general it is concluded that all current Regge-cut models are seriously affected by the set of constraints —even in the case of the "unproblematic" class of hadronic reactions, dominated by vector and tensor exchange. In particular the following results were found: the real parts of the helicity-nonflip amplitudes are wrong, i.e., by far too much adsorbed, in the Michigan as well as in the Argonne model; moreover in the Michigan model the real parts of the helicity-flip amplitudes are wrong, too, there is much support for wrong signature nonsense zeros in the Regge-pole input and the correct crossover of elastic differential cross section does not necessarily imply very strong absorption. Altogether a weak cut type model —if any —seems to be favored for the imaginary parts of the amplitudes. The real parts should then be calculated from fixed t-dispersion relations. (auth)

1003 (ITF-71-24-E) ALGEBRAIC STUDY OF CURRENT ALGEBRAS AND THEIR REPRESENTATIONS. Klimyk, A. U. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 35p. Dep. NTIS (U. S. Sales Only).

An algebraic study is made of current algebras and their representations. The form of all the ideals of current algebras is derived. A notion of involutive universal enveloping algebra of current algebras is introduced, by means of which a study is made of the linear representations of current algebra. (auth)

1004 (NP-19028) EXACT SOLUTION OF A TIME-DEPENDENT QUANTAL HARMONIC OSCILLATOR WITH A SINGULAR PERTURBATION. Note No. 301. Camiz, P.; Gerardi, A.; Marchioro, C.; Presutti, E.; Scacciatelli, E. (Rome Univ. (Italy). Istituto di Fisica). 14 Jan 1970. 18p. Dep. NTIS (U. S. Sales Only).

The quantal problem of a particle interacting in one dimension with an external time-dependent quadratic potential and a constant inversely quadratic potential is exactly solved. The solutions are found both in the Schroedinger representation by using a generating function or a time dependent raising operator, and in the Heisenberg picture. They depend only on the solution of the classical harmonic oscillator. The generalizations to the n-dimensional problem and to the problem of N particles in one dimension interacting pairwise via a quadratic time dependent potential and a constant inversely quadratic potential, are finally sketched. (auth)

1005 (NYO-2262-TA-246) HIGH ENERGY INCLUSIVE PROCESSES. Tan, Chung-I (Brown Univ., Providence, R. I. Dept. of Physics). [1971]. 22p. (CONF-710633-1). Dep. NTIS.

From Meeting on high energy collisions on nuclei and particle production; Titisee, Germany (7 Jun 1971).

A brief survey is given on recent developments in the study of inclusive processes. A separation is made between the kinematical and dynamical aspects by using the Mueller analysis. The dual resonance model and the multiperipheral model are used to show the nature of the Mueller Regge hypothesis. (J.F.P.)

1006 (NYO-3178-9) REVIEW OF RESEARCH IN ELEMENTARY PARTICLE PHYSICS: 1968-1971. Kirsch, Lawrence; Schnitzer, Howard (Brandeis Univ., Waltham, Mass. Dept. of Physics). 30 Jun 1971. Contract AT(30-1)-3178. 52p. Dep. NTIS.

The research on elementary particle covers the history, accomplishments and future directions of the program as well as the technical facilities. Both theoretical and experimental studies are covered. A list of publications is included. (J.F.P.)

1007 (PAM-71-6) MELLIN TRANSFORMATION METHOD FOR NON-POLYNOMIAL INTERACTIONS. Houard, J. C.; Irac-Astaud, M. (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). Jul 1971. 23p. Dep. NTIS (U. S. Sales Only).

The x- and p-space methods for nonpolynomial interactions are studied and compared. The validity of p-space method is discussed. It appears that the latter has to be generally amended if it has to converge. For that purpose x-space formula is cast in a new form similar to the p-space one. Its arbitrariness is investigated and its unitarity checked. (France)

1008 GENERAL FORMULATION OF INCLUSIVE SUM RULES. Predazzi, E. (Univ., Turin); Veneziano, G. Lett. Nuovo Cim.; 2: No. 15, 749-54(9 Oct 1971).

Sum rules which relate different inclusive cross sections in a way independent of the multiplicity are discussed. Starting with an algebraic identity the sum rules are written in a general, compact, and simple form. It is shown that the sum rules have strong implications for the correlation functions in n-particle distributions. (J.F.P.)

1009 ROLE OF THE RESULTS OBTAINED BY THE ANALYTICAL THEORY OF ELEMENTARY PARTICLES. Tran Huu Phat (Hanoi Univ., North Viet-Nam). Ann. Phys. (Leipzig); 27: No. 1, 33-46(1971).

It is proven that it is possible to obtain many results (such as the asymptotic relations of the Pomeranchuk type, Froissart inequality, Martin theorem, etc.) of the analytical theory of elementary particles in any theory where the ordinary analyticity of dispersion amplitude is replaced by a certain generalized analyticity (such as the p-analyticity of Poloji, the generalized analyticity of Vekua). Hence one cannot consider these results as criteria for the validity of the analyticity at high energies.

Therefore, in order to check the analyticity one ought to establish the relations which can not be deduced from any generalized analyticity, except ordinary analyticity. (auth)

Electromagnetic

Refer also to abstract 993.

1010 (BNL-16173) SCALING LAWS IN HIGH ENERGY PHYSICS. Preparata, Giuliano (Rome Univ. (Italy). Istituto di Fisica. Brookhaven National Lab., Upton, N. Y.). Sep 1971. 31p. (CONF-701137-1). Dep. NTIS.

From Meeting of the Italian Physical Society; Venice, Italy (Nov 1970).

A general survey of physics with the aid of the light cone expansions of products of local operators is given. Deep inelastic electron-proton scattering and massive μ pair production in p + p interactions are considered. (J.F.P.)

1011 (DESY-71/43) VECTOR MESON DOMINANCE AND $\pi\Delta(1236)$ ELECTROPRODUCTION. Bartl, A.; Schildknecht, D. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug 1971. 27p. Dep. NTIS (U. S. Sales Only).

Predictions for $\pi\Delta(1236)$ electroproduction are given within the framework of vector meson dominance. Comparison with experimental results on $ep \rightarrow e\pi^+\Delta^0$ shows good agreement. (auth)

1012 (NP-19022) LIGHT CONE EXPANSION AND CORRECTIONS TO VECTOR MESON DOMINANCE IN COMPTON SCATTERING. Note No. 300. Altarelli, G.; Preparata, G. (Rome Univ. (Italy). Istituto di Fisica). 13 Jan 1971. 11p. Dep. NTIS (U. S. Sales Only).

The corrections to vector meson dominance relating high-energy Compton scattering and ρ-photoproduction at t = 0 are estimated using the operator expansion near the light cone and the experimental results on deep inelastic electron scattering. (auth)

1013 FINITE ENERGY SUM RULES FOR FORWARD COMPTON SCATTERING. Kugler, M. (Weizmann Inst. of Science, Rehovot, Israel. Univ. of California, Santa Barbara); Milgrom, M. Ann. Phys. (N. Y.); 66: No. 1, 335-50(Jul 1971).

The resonance saturation of finite energy sum rules for forward Compton scattering by protons and neutrons is discussed. With rather low cutoff the high-energy Regge behavior, except the Pomeranchuk trajectory, can be predicted. This agrees with experiment where data are available. In addition to moving poles, fixed poles are present. These cannot be completely obtained from resonances alone. Mechanisms that make the fixed poles disappear as q^2 is varied from zero to m_p^2 are discussed. (auth)

1014 VARIABLE STARS AND THE PHOTON REST MASS. Breinhorst, R.; Reinhardt, M. (Univ., Bonn). Ann. Phys. (Leipzig); 27: No. 1, 122-4(1971).

The differences in the times of minima in the light curves of eclipsing binaries at different wavelengths are considered. It is found that none of the previous observations shows errors in the previous results on the frequency independence of the velocity of light in vacuum. (J.F.P.)

1015 OPERATOR PRODUCTS AT ALMOST LIGHT LIKE DISTANCES. Frishman, Y. (Weizmann Inst. of Science, Rehovot, Israel). Ann. Phys. (N. Y.); 66: No. 1, 373-89(Jul 1971).

The recently proposed expansion of products of local operators when their space-time distance approaches the light cone is motivated and discussed. Attempts to prove the expansion from Wilson's short distance expansion are analyzed. Applications to processes involving currents in certain asymptotic domains are reviewed and difficulties are pointed out. (auth)

1016 RELATIVISTIC QUASIPOTENTIAL EQUATIONS IN THE CASE OF ELECTROMAGNETIC INTERACTIONS. Ilchev, A. S.; Mateev, M. D. God., Sofii. Univ., Fiz. Fak.; 63: 7-23 (1968-1969).

The application of the quasipotential approach to systems of particles which interact electromagnetically is studied. Electron-positron and Compton scattering are considered. The purpose is to give tools for investigating electrodynamics, such as diagram rules, equations for the scattering matrix and wave functions, and the spin structure of the quasipotential. Some specific features due to the zero mass of the photon are stressed, and some applications such as constructing the quasipotential in the second order of the coupling constant are also made. (J.F.P.)

1017 CALCULATION OF ELECTROMAGNETIC SHOWERS IN LEAD WITH AN INITIAL ENERGY OF 6 GeV. Varfolomeev, A. A.; Drabkin, L. B. Kosm. Luchi; No. 12, 32 60(1970). (In Russian).

The spatial development of electromagnetic cascades at an initial energy of 6 GeV in lead at depths up to 10 times the radiation length for lead was calculated. Among the values found were those for the energy spectra of electrons and positrons, the cascade longitudinal development and radial and angular distributions, and fluctuations in the number of particles. (J.F.P.)

1018 FUNDAMENTAL ELECTROMAGNETIC PROPERTIES OF THE NEUTRON. Aleksandrov, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 547-83 of Problemy Fiziki Elementarnykh Chastits i Atomnogo Yadra. Tom 1, Vypusk 2. /Bogolyubov, N. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

Experimental papers devoted to fundamental electromagnetic properties of a neutron, such as: electrical charge, electrical dipole moment, electromagnetic form factors, polarizability, and (n-e) interaction are reviewed. (auth)

Weak

1019 (CERN-71-18) EVALUATION OF THE UNITARY ENERGY LOSS AND RANGE OF 2- TO 600-GeV MUONS IN AN ABSORBING MEDIA. Richard-Serre, C. (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Sep 1971. 63p. (In French). Dep. NTIS (U. S. Sales Only).

When a muon of high energy (>5 GeV) passes through matter, ionization phenomena are no longer solely responsible for its slowing down. Pair production and bremsstrahlung become important. The evaluation of all these losses is useful for future accelerators (300 and 1000 GeV). For example, shielding calculations and the production of a neutrino beam are dominated by the absorption of high-energy muons. Tables and curves are given for the total energy losses and range of muons between 2 and 600 GeV for various materials. (tr-auth)

1020 TWO-COMPONENT POINCARE-INVARIANT EQUATIONS FOR MASSIVE CHARGED LEPTONS. Biedenharn, L. C. (Duke Univ., Durham, N. C.); Han, M. Y.; van Dam, H. Phys. Rev. Lett.; 27: No. 17, 1167-70(25 Oct 1971).

An alternative to Dirac's factorization of the Klein-Gordon equation is developed; the resulting two-component, $m \neq 0$ equations are proved Poincaré invariant. The particles interact chirally and minimally with the electromagnetic field (g = 2). The equations yield factorizations of Kramers's equations and a conserved chiral current (without γ_5 projection) to implement in a natural way the Feynman-Gell-Mann approach to weak interactions. Besides possessing sharp chirality, the particles possess a new dichotomic quantum number. (auth)

1021 HIGH ENERGY NEUTRINO REACTIONS THROUGH AN INTERMEDIATE BOSON. El-Khishen, M.; Mansour, H. M. (Cairo Univ.). Ann. Phys. (Leipzig); 27: No. 2, 145-8(1971).

The cross sections for the antineutrino process $\bar{\nu} + p \rightarrow n + e^+$ are calculated in the theory of weak boson interaction. The dependence of the cross section on the mass of the intermediate vector boson is explicitly shown. It is assumed that all form factors have the same analytic form and the same effective mass as that of the isovector part of the nucleon electromagnetic form factor. (auth)

1022 LEPTON PARTICIPATION IN THE DECAY OF HADRONS. Mal'tsev, E. I.; Chuvilo, I. V. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 443-524 of Problemy Fiziki Elementarnykh Chastits i Atomnogo Yadra. Tom 1, Vypusk 2. /Bogolyubov, N. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The main properties of leptonic hadron decays in accordance with present day views on the theory of weak interactions are considered in this review. The decay properties of π- and K-mesons are described and the experimental data till summer 1969 are analyzed. The analysis of leptonic baryon decays in the framework of $SU_{(3)}$-symmetry is considered. (auth)

1023 FINAL STATE INTERACTIONS IN π^- MESIC DECAYS OF HYPERNUCLEI. Deloff, A. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol.; B2: No. 5, 589-613(Sep-Oct 1971).

Final-state interactions in the three- and four-body π^- mesic decays of hypernuclei are considered, and a general formalism is developed which enables calculation of the angular and energy distributions. The distorted-wave impulse approximation is applied to account for final-state interactions. Spin effects, many channels, and Coulomb interactions are discussed in detail. The derivation of the basic formulas is included. (auth)

Strong (General)

1024 (CONF-690217-, pp 226-37) NONRELATIVISTIC QUARK MODEL. Frankfurt, L. L. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

Work is in progress on symmetry systems for strongly interacting particles, i.e., hadrons; however, no broad symmetry system, including the charge, hypercharge, and the spin has been developed. The observed approximate symmetry may be interpreted simply on the basis of the Gell–Mann and Zweig's quark model. That model is based on the assumption that all hadrons consist of several quark particles, possessing a fractional charge Q and a baryon number B equal to $\frac{1}{3}$. Classification and electromagnetic properties of the hadrons, their high-energy scattering, and proposed models are reviewed. These models, based on the assumptions that mesons consist of 2 and baryons of 3 independent particles, satisfy the experimental data; however, search for quarks has been unsuccessful. Uncertainties consist concerning the potential combination of theories involving the point nature of quarks with a "mason" and nonrelativistic properties with high bond energy. Most contradictions may be eliminated by considering the quarks as quasiparticles; however, no concepts postulate the formation of quasiparticles with a fractional charge. (TTT)

1025 (ITF–71-73-E) DUAL MODELS WITH MANDELSTAM ANALYTICITY. Bugrii, A. I.; Enkovski, L. L.; Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 20p. Dep. NTIS (U. S. Sales Only).

Various aspects of dual models with Mandelstam analyticity are studied. A procedure for the removal of multifold poles appearing on daughter levels is discussed. (auth)

1026 (NP–19039) PHENOMENOLOGY OF HYPERCHARGE EXCHANGE REACTIONS. Sadoulet, Bernard (Paris Univ., Orsay (France)). 1971. 314p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The study of the phenomenology of hypercharge-exchange reactions covers exotic exchange, exchange degeneracy, and the analysis of hypercharge-exchange reactions. Strong interactions are considered. (J.F.P.)

1027 (ORO–3992-63) MAGNETIC QUARKS AND ELECTRIC QUARKS IN HADRONS. Chang, Chen-Kun (Texas Univ., Austin. Center for Particle Theory). 23 Jul 1971. 44p. (CPT–113). Dep. NTIS.

Dirac's magnetic monopoles are generalized to have aspects which are similar to the conventional quarks (electric quarks). Such magnetic monopoles are called magnetic quarks. It is assumed that a baryon consists of three solid bodies called electromagnetic quarks, and that an electromagnetic quark and an anti-electromagnetic quark form a meson. Each of these electromagnetic quarks is considered to be composed of one electric quark and one antimagnetic quark. Such speculation solves the difficulty in statistics faced by the paraquark model. New baryon mass relations and magnetic moments were derived. Finally, a strong electric dipole moment is predicted to exist in a baryon state with nonzero electromagnetic quark-orbital angular momentum, $L \neq 0$. (auth)

1028 LINE-REVERSAL SYMMETRY BREAKING AND THE ABSORPTION CORRECTIONS. Fialkowski, K. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B2: No. 5, 669-78(Sep-Oct 1971).

The role of absorption corrections in the experimentally observed line-reversal symmetry breaking is discussed. The absorption parameters are estimated from experimental data and the quark model. It is shown that the absorption corrections cannot explain the experimentally observed effect. (auth)

Strong (Baryon No. = 0)

1029 (CONF-690217–, pp 138-62) ANOTHER DISCUSSION OF THE PION–PION INTERACTION. Araf'ev, A. V.; Leksin, G. A. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

The $\pi\pi$ interaction has been the subject of many papers although most of them are speculative and do not contain new experimental data; many of the reported values are contradictory. The problems considered included cross section studies, polar approximation on the basis of Kaidalov's and Regge's theories, $\pi^+ - \pi^+$-scattering, form-factors, pseudoperipheral approximation of Chu and Low, the isotopic invariance in the $\pi\pi$ interaction, and determination of the criteria needed for the clarification of $\pi^+ - \pi^+$-reaction. Further work is required to improve the statistical basis in the high-momentum range of pions, and to clarify the $\pi + n \rightarrow \pi^0 + \pi^0 + p$ reaction. (Review article, 52 references). (TTT)

1030 (CONF-710717–1) EXPLICIT EXPRESSIONS OF THE POTENTIAL AND ITS DERIVATIVES AT THE ORIGIN IN TERMS OF THE SCATTERING DATA. Note No. 316. Calogero, F. (Rome Univ. (Italy). Istituto di Fisica. Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 11 May 1971. 76p. Dep. NTIS (U. S. Sales Only).

From Workshop on the mathematics of profile inversion; Moffet Field, Calif. (12 Jul 1971).

The framework of this review paper is the quantum-mechanical theory of scattering of a particle by a spherically symmetrical potential. The point of view is that characterizing the inverse scattering problem; the input of the calculation are the scattering and bound state data, the output is information on the potential. The results discussed are explicit expressions for the values of the potential and its derivatives at the origin, in terms of the scattering and bound-state data. Various methods to obtain these results are outlined. The presentation is aimed at introducing these various approaches; the simplest scattering problem (nonrelativistic S-wave scattering on a holomorphic potential without bound states) is used as the basis for discussion, and technicalities are skipped whenever possible without loss of clarity. A complete compilation of the results obtained up to now in this field is reported, including the treatment of higher partial waves, and of the Klein-Gordon and Dirac equations. (auth)

1031 (SU-1206-252) GENERAL CONSIDERATIONS ON THE DERIVATION OF INEQUALITIES FOR THE s- AND p-WAVE π-π PARTIAL-WAVE AMPLITUDES. Balachandran, A. P. (Syracuse Univ., N. Y. Dept. of Physics. Istituto Nazionale di Fisica Nucleare, Naples (Italy)); Blackmon, Maurice L. (Syracuse Univ., N. Y. Dept. of Physics). [1971]. 36p. (NYO-3399-252). Dep. NTIS.

A class of inequalities for the pion-pion s- and p-waves was discussed recently. An attempt is made to provide a systematic method for writing such inequalities. An infinite number of new inequalities for the pion-pion s- and p-waves are also derived. (auth)

1032 SELF-CONSISTENT PION–PION INTERACTION FOR p-WAVE WITH SINGULAR N/D EQUATIONS. Weigt, G. (Institut fuer Hochenergiephysik, Zeuthen, Ger.). Ann. Phys. (Leipzig); 27: No. 2, 189-98(1971). (In German).

A marginal singular integral equation is solved numerically for a simple cutoff-model with additional singular short range forces using the Atkinson–Contogouris-method. Bassetto's and Paccanoni's parameterfree ρ-meson calculation is investigated for cutoff $\Lambda \rightarrow \infty$. (auth)

1033 MULTIPLE-MESON PRODUCTION AND THE EXTENDED-PARTICLE MODEL OF ELEMENTARY PARTICLES. Hwang, Jen-lin (National Taiwan Univ., Taipei). Chin. J. Phys. (Taiwan); 9: No. 1, 24-8(Apr 1971).

It is pointed out that the phenomenon of multiple-meson production in a proton-antiproton annihilation provides an experimental evidence for a validity of the extended particle model of elementary particles. It is shown that the scheme of energy levels of produced mesons in p-$\bar{p}$ annihilation at rest is similar to that of an even–even nucleus, and that the spectrum can be decomposed fairly into the rotational, β-vibrational and γ-vibrational bands. The spectrum can be explained from the Hamiltonian derived previously for the complete liquid drop model of elementary particles. (auth)

1034 MODEL FOR THE SCATTERING AMPLITUDE OF PSEUDOSCALAR π-MESONS. Zlatev, I. S.; Isaev, P. S.; Popov, Khr. D. God. Sofii. Univ., Fiz. Fak.; 63: 25-48(1968–69). (In Bulgarian).

A model for the $\pi-\pi$ scattering amplitude is proposed, which satisfies several conditions as Mandelstam analyticity, crossing symmetry and two-particle unitarity. The last condition is not discussed but a method for its approximate satisfaction is sketched. The model has a right position of the first cuts for each channel and has no other singularities on the physical sheet. It is shown that the maxima of the scattering amplitude (in particular–ρ-resonance in the isotopic spin I = 1 p-wave of the amplitude) can be interpreted as a result of the singularities of the model on the unphysical sheet. (auth)

Strong (Baryon No. = 1)

1035 (CALT–68-334) PAST LESSONS AND FUTURE DREAMS FROM POLARIZATION DATA IN HIGH-ENERGY PHYSICS. Fox, Geoffrey (California Inst. of Tech., Pasadena). [1971]. Contract AT(11-1)-68. 63p. (CONF-710815–2). Dep. NTIS.

From second international conference on polarized targets; Berkeley, Calif. (30 Aug 1971).

One dreams about future experiments with polarized targets. One considers R and A measurements in genuine two-body reactions and finds by Monte Carlo techniques the statistical accuracy necessary to adequately reconstruct the underlying amplitudes. This turns out to be ±20% in $\pi^+p \to K^+\Sigma^+$ but in π^+p elastic, measurements of R to ±3% are required. Then predictions are given for the polarization in single resonance production, e.g., $\pi N \to \pi\Delta$ and $\pi N \to \rho N$. The latter has particularly large and striking polarization and in either case the density matrix elements of the final resonance allow amplitude reconstruction without analyzing the final baryon polarization. Finally it is shown that polarization measurements in multiparticle final states will clarify the resonance status of the many threshold enhancements (A_1, N^*_{1400}, Q, L, Z*, etc.). Explicit predictions are given for the Q, N^*_{1400}, and Z*. In general, the importance of the difficult geometry with polarization in the production plane and in the multiparticle experiments is noted, and polarized target experiments are contrasted with those that analyze the final baryon polarization off an unpolarized target. (auth)

1036 (DESY-71/41) IMPLICATIONS OF FINITE ENERGY SUM RULES IN PION–HYPERON SCATTERING. Renner, B.; Zerwas, P. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug 1971. 20p. Dep. NTIS (U. S. Sales Only).

A possible $I = 2$ $(\Sigma\pi)$-resonance was previously proposed on the basis of questionable unsubtracted dispersion relations for the crossing-symmetric A-amplitudes in $(\pi\Lambda)$ and $(\pi\Sigma)$-scattering, saturated by the known resonances and required to reproduce the Adler consistency conditions. In a search for alternative mechanisms to restore consistency without exotic states, finite energy sum rules are introduced instead of unsubtracted dispersion relations, and the hypothesis that saturation is achieved by the exchanges of f and ϵ trajectories is examined. By comparing the resultant Regge residues with the high energy polarization data in K ± P scattering, attributed to A_2-pomeron interference, the approximate magnitude of the required f contribution is confirmed by SU(3), and the ϵ-contribution is checked against the corresponding sum rule in the πN system. Approximate consistency of these tests eliminates the need for exotic resonances. (auth)

1037 (DESY-71/42) ON THE PROBLEM OF THE SIGMA TERMS IN MESON–BARYON SCATTERING. COMMENTS ON RECENT LITERATURE. Renner, B. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug 1971. 13p. Dep. NTIS (U. S. Sales Only).

A recent controversy about the value of the sigma term in pion–nucleon scattering is reviewed, with particular attention to possible attempts to reconcile a previous large value with the (3,3*) + (3*,3) chiral symmetry breaking model. Grounds for reservations may be found for each one of three mechanisms considered. Thus the general belief is confirmed that the conventional theory of chiral symmetry breaking cannot be easily maintained, unless the previous value is given up in favor of a reestimate. (auth)

1038 (ISS-71/5) MAGNITUDE OF THE σ-TERM, CHIRAL SYMMETRY AND SCALE INVARIANCE. Altarelli, G.; Cabibbo, N.; Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 6 May 1971. 12p. Dep. NTIS (U. S. Sales Only).

The result of Cheng and Dashen: $\sigma_{NN} \simeq 110$ MeV is in agreement with a smooth behavior of the π–N amplitude, and consistent with $(3,\bar{3})$ breaking of chiral SU(3) ⊗ SU(3), with almost exact SU(2) ⊗ SU(2). This result is also found to give a strong suggestion for an approximate scale invariance of hadron dynamics. (auth)

1039 (ITF-71-51-E) DUALITY IN MANY BODY PRODUCTION PROCESS. Ranft, Gisela (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 14p. Dep. NTIS (U. S. Sales Only).

By means of spin and parity analysis the concepts of global and of local duality are studied in processes $\pi p \to \rho\pi p$ and $\pi p \to \epsilon\pi p$. (auth)

1040 (JINR-P2-6038) MODEL-INDEPENDENT DETERMINATION OF ZEROS OF THE K^+p FORWARD SCATTERING AMPLITUDES. Dumbrais, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

The locations of zeros of the K^+p forward scattering amplitudes are calculated by means of the analytical continuation of the scattering amplitude parametrized in the physical region to the complex values of the energy. The method exploits the known analyticity properties of the scattering amplitude and experimental data in a limited energy range. However, unlike conventional dispersion relation calculations, it requires no assumptions about the residues of the hyperon pole terms and the amplitudes in the unphysical and asymptotic regions. (auth)

1041 (NP-19023) MAGNITUDE OF THE σ-TERM, CHIRAL SYMMETRY AND SCALE INVARIANCE. Note No. 317. Altarelli, G.; Cabibbo, N.; Maiani, L. (Rome Univ. (Italy). Instituto di Fisica). 18 May 1971. 12p. Dep. NTIS (U. S. Sales Only).

A previous result: $\sigma_{NN} \simeq 110$ MeV is in agreement with a smooth behavior of the π–N amplitude, and consistent with $(3,\bar{3})$ breaking of chiral SU(3) ⊗ SU(3), with almost exact SU(2) ⊗ SU(2). This result is also found to give a strong suggestion for an approximate scale invariance of hadron dynamics. (auth)

1042 (RHEL/R-224) COEFFICIENTS FOR PARTIAL WAVE ANALYSIS OF THE REACTION $0^- + \frac{1}{2}^+ \to 1^- + \frac{1}{2}^+$. Bramdstetter, A.; Deen, S. M.; Litchfield, P. J. (Rutherford High Energy Lab., Chilton (England)). Aug 1971. 98p. Dep. NTIS (U. S. Sales Only). UK Pound 1.00.

Coefficients for the Legendre polynomial expansion of differential cross sections and density matrices are calculated in terms of partial wave amplitudes. Tables for the reaction $0^- + \frac{1}{2}^+ \to 1^- + \frac{1}{2}^+$ are presented. (auth)

1043 CREMONA PROBLEMS RELATED TO STATIC PION NUCLEON THEORY. Kaiser, H. J. (Institut fuer Hochenergiephysik, Zeuthen, Ger.). Ann. Phys. (Leipzig); 27: No. 2, 149-60(1971).

Certain mathematical aspects of the static pion–nucleon theory are investigated. The starting point is the fact that the theory in its uniformized form (cuts transformed away) leads to a system of functional equations for the S-matrix. The nonlinear mapping involved in the functional equations is a second-order Cremona transformation. After a summary of the general properties of Cremona transformations, the special transformations are studied which arise in the symmetric scalar and the Chew–Low theory respectively. The emphasis is on the possibility to separate, by means of a finite-order Cremona transformation, the functional equations into a set of uncoupled ones. For the symmetric scalar theory, the separation is trivial. For the Chew–Low theory, a proof of nonseparability is given. (auth)

1044 SPIN STRUCTURE OF THE ABSORPTION CORRECTIONS TO THE STODOLSKY–SAKURAI MODEL. Gizbert-Studnicki, P. (Jagellonian Univ., Krakow); Golemo, A.; Zalewski, K. Acta Phys. Pol.; B2: No. 5, 679-87(Sep-Oct 1971).

The absorption correction to the Stodolsky–Sakurai model is decomposed into two parts. The first part differs from the pole term only by a spin independent factor. Consequently, it does not affect the spin density matrix. The corrections that change the density matrix are small. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 1166, 1385, and 1386.

1045 (CERN-Trans-71-28) MODEL-INDEPENDENT DETERMINATION OF THE REAL PARTS OF THE pp FORWARD SCATTERING AMPLITUDES NOT ALLOWING FOR SPIN EFFECT. Dumbrais, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by R. Luther (CERN, Geneva, Switzerland), from report JINR-P2-5448. 17p. Dep. NTIS (U. S. Sales Only).

The results of a calculation of the real parts of the p+ p amplitudes are given. For this calculation a new model-independent method is used. (J.F.P.)

1046 NUCLEAR INTERACTION OF NONIONIZING N COMPONENTS OF COSMIC RAYS IN LEAD AT SEA LEVEL (12^9N). Bhattacharyya, D. P.; Das, N. C. (Presidency Coll., Calcutta. Jadavpur Univ., Calcutta). Ann. Phys. (Leipzig); 27: No. 2, 222-4(1971).

The production rate of nuclear interactions by neutral N-component of cosmic-rays of mean energy 15 GeV at sea level was studied as function of absorber thickness by means of a cloud chamber operated by coincidence and anticoincidence technique. The value of collision free path of nonionizing N-rays in lead was found to be 232 ± 29 g/cm² and the collision cross section 1.50 ± 0.19 bn. The estimated nucleon inelasticity for pion production in these interactions was 0.4. (auth)

Particle Invariance Principles and Symmetries

Refer also to abstract 1082.

General

1047 (CONF-690217–, pp 210-25) PROOF OF THE CPT-INVARIANCE. Okun, L. B. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

The CPT-invariance is one of the most basic symmetries of physics; its experimental verification is especially important in view of the demonstration of the nonconcentration of the C-, P-, and CP-invariances. The CPT invariance requires when the masses and lifetimes of particles and antiparticles are equal, their electric and magnetic moments differ only by their sign and interact similarly with the gravitational field. The equality of electromagnetic and gravitational peaks may be proven by examining the scattering amplitude of the particles in an external electromagnetic or gravitational field, keeping in mind that the photon is CPT-odd and the graviton is CPT-even. The experimental proof of the consequences of the CPT-invariance was examined, pointing out that no case of conservation of this invariance has been observed. The equality of lifetimes and magnetic moments has been demonstrated. Decay of neutral K mesons also offers an opportunity to prove the CPT invariance. The theoretical meaning of the possible discovery of the nonconservation of this invariance was examined. Within the framework of the Lagrangian field theory, the fact that nobody succeeded in deriving a CPT-noninvariant Lagrangian is considered a practical illustration of the Luders–Pauli CPT-theorem. It is difficult to imagine that nonconservation of this invariance could exist without changing radically the whole field theory, relativistic invariance, etc. (TTT)

1048 (ORO-3992-70) INTRODUCTION TO THE THEORY OF GROUPS AND GROUP REPRESENTATIONS. Strom, Staffan (Texas Univ., Austin. Center for Particle Theory). Spring 1971. 166p. (CPT-120). Dep. NTIS.

A survey is given of the general results required for an understanding of the theory of the unitary irreducible representations of the Lorentz and Poincare groups. The lectures cover abstracts and topological groups, Lie groups and algebras, group representations, representation theory of bicompact groups, and induced representations of locally bicompact groups with applications to semi-simple Lie groups and a semi-direct product. (J.F.P.)

1049 SYMMETRY PROPERTIES OF THE 3j SYMBOLS OF SU(n). Derome, Jean-Robert; Jakimow, G. (Univ. of Montreal). Can. J. Phys.; 48: 2169-75(15 Sep 1970). (In French).

For an arbitrary compact group it is not in general possible to choose the 3j-symbol $(j_1j_2j_3)_{r,m_1m_2m_3}$ such that its absolute value is invariant under every permutation of the j's and of the corresponding m's. For SU(3) this choice is possible. It is shown here that for SU(n) such a choice is not possible. (auth) (Canada)

Applications (Electromagnetic and Weak)

Refer also to abstract 1022.

1050 (NP-19025) PION ELECTROPRODUCTION ON POLARIZED PROTONS NEAR THE SINGLE PION THRESHOLD AS A TEST OF T-INVARIANCE. Note No. 303. Balla, M.; Marini, G. (Rome Univ. (Italy). Istituto di Fisica). 21 Jan 1971. 24p. Dep. NTIS (U. S. Sales Only).

The study of single pion electroproduction on polarized nucleons, near threshold, is suggested as a significant test of invariance under T of the e.m. interaction of hadrons. The cross sections and the asymmetries for such a process are deduced and numerical evaluations of the effect are given. (auth)

1051 (SU-4205-253) CP VIOLATION AND CHIRAL SYMMETRY. Schechter, J.; Ueda, Y. (Syracuse Univ., N. Y. Dept. of Physics). Aug 1971. 11p. (NYO-3399-253). Dep. NTIS.

CP violation terms belonging to the $\{3,3^*\}$ and $\{3^*,3\}$ chiral representations are discussed with the help of a general form of the SU(3) σ-model. The formalism is developed for calculation with such terms and numerical estimates are given. It is noted that the electric dipole moment of the neutron may be calculated very simply in this approach and the results serve to rule out most models of this type. (auth)

1052 TESTS OF TCP INVARIANCE IN NEUTRAL KAON DECAYS. Dass, G. V. (Rutherford High Energy Lab., Chilton, Eng.); Kabir, P. K.; Kenny, B. G. Proc. Roy. Soc. (London), Ser. A; 325: No. 1560, 101-19(5 Oct 1971).

A systematic account is given of the tests which can be made of TCP invariance, through the relations imposed by that symmetry between the observable parameters in neutral kaon decay. It is shown how different relations test the TCP invariance of different types of interactions. Tests of TCP invariance given previously in the literature are categorized according to the classification given. (auth)

Applications (Strong)

1053 (NYO-2262-TA-251) IS SU(3) x SU(3) REALIZED WITH GOLDSTONE BOSONS. Olshansky, R. (Brown Univ., Providence, R. I. Dept. of Physics). [1971]. 25p. Dep. NTIS.

The linear σ-model is used to study how full chiral symmetry is realized as the $(3,3^*) + (3^*,3)$ interaction is turned off. The Lagrangian which fits the observed spin zero mass spectrum chooses either a normal realization with degenerate SU(3) × SU(3) multiplets or a Goldstone realization with an octet of massless pseudoscalar mesons, depending on whether the mass term of the Lagrangian is greater or less than a certain critical value. The value of the mass term depends sensitively on the masses of the I = 0 scalar resonances and present knowledge of these masses is compatible with either type of realization. However, the values of the nucleon sigma commutators calculated from meson-nucleon scattering data can resolve this issue. For the normal solution the $\pi - N$ sigma commutator is predicted to be about 75 MeV, whereas for the Goldstone solution the prediction is 30 MeV. The symmetry breaking parameters are a = −.91 and b = −.16 independent of how full symmetry is achieved. (auth)

Field Theories

General

1054 STATISTICS OF NEUTRAL FERMIONS WITH ANOMALOUS MAGNETIC MOMENTS IN EXTERNAL MAGNETIC FIELDS. Dyllong, U. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 27: No. 2, 182-8(1971). (In German).

The equation of state of a relativistic uncharged Fermi particle gas in a magnetic field is calculated using the exact solutions of the Dirac–Pauli equation for an uncharged Fermi particle with an anomalous magnetic moment. It is found that the stress-energy tensor is anisotropic. The anisotropy is introduced by the anisotropy of energy states. (auth)

Quantum Field Theory

Refer also to abstract 1016.

1055 (DESY-71/48) SUPERPROPAGATORS OF NON-LOCALIZABLE FIELDS. Flume, R. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug 1971. 11p. Dep. NTIS (U. S. Sales Only).

Arguments are given for a special choice of the superpropagator corresponding to Wightman-two-point-functions with an increase in momentum space as $e^{\kappa|p^2|^{\frac{1}{2}}}$, $\kappa > 0$. (auth)

1056 (FRNC-TH-60) (V,N) SECTOR OF THE LEE MODEL. Fabre, Gerard (Paris Univ. (France). Faculte des Sciences). [nd]. 45p. (In French). Dep. NTIS (U. S. Sales Only). Thesis.

The Lee model of quantum field theory is presented in hibertian state space and also in a nonhibertian space with an indefinite metric. The differences between both theories are examined in the (1,1) sector. The (2,1) sector is then considered. The first theory is used for studying the case with a renormalized g^2 coupling constant greater than the critical value g_c^2. In the case when $g^2 > g_c^2$, a difficulty due to a ghost state arises and the theory is no longer coherent. The equations are reconsidered using a new Hamiltonian and new commutation and anticommutation relations; an attempt is made to solve these equations. A new problem arises. In the case of a positive definite metric, the equations can always be written in terms of the renormalized quantities, this is not always possible for an indefinite metric. (France)

1057 (ITF-71-36-P) QUANTUM WAVE EQUATION IN FIELD THEORY. Brezhnev, V. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

A new approach to the construction of the quantum field theory is developed which is similar to the Schrödinger representation of quantum mechanics. The wave equation for the amplitude of probability for the arbitrary system of fields including the gravitational one is constructed on the basis of a previous canonic formalism. (tr-auth)

1058 (ITF-71-37-E) ON THE EQUATIONS FOR THE MATRIX ELEMENTS ON THE EUCLIDEAN QUANTUM ELECTRODYNAMICS. Rebenko, A. L. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 44p. Dep. NTIS (U. S. Sales Only).

The equations of the S-matrix elements of Euclidean quantum

electrodynamics are obtained. The generating operator of these equations is investigated. On the basis of analogy between the interaction Hamiltonian and the generating operator one succeeds in proving (under some restrictions on the form factor) the convergence of the perturbation series for the arbitrary values of coupling constant. (auth)

1059 (ITF-71-38-E) ON CONVERGENCE OF THE PERTURBATION SERIES IN THE FIELD THEORY MODELS CONTAINING FERMIONS. Ivanov, S. S.; Rebenko, A. L. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 27p. Dep. NTIS (U. S. Sales Only).

The problems of convergence of the perturbation series in the Euclidean domain for the models containing fermions are investigated. Some estimates are presented which characterize a possible rapidity of divergence on removing the cutoffs. A nonlocal variant of the theory is briefly investigated. (auth)

1060 (ITF-71-52-P) ASYMPTOTIC FIELDS FOR THE APPROXIMATED RENORMALIZED TWO-DIMENSIONAL MODEL $(:P(\varphi_\kappa)(g): + Y(g,\kappa))_2$. Yakymiv, Ya. M. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 26p. (In Russian). Dep. NTIS (U. S. Sales Only).

The $(:P(\varphi_\kappa)(g): + Y(g,\kappa))_2$-theory, where $:P(\varphi_\kappa)(g)$ is a boson self-interaction and $Y(g,\kappa)$ is the Yukawa interaction is considered. The existence of asymptotic fields for this model is proved and the properties of these fields are investigated. (auth)

1061 (ITF-71-57-E) QUASISPIN MODEL WITH POSITIVE INTERACTION. Shumovskii, A. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 15p. Dep. NTIS (U. S. Sales Only).

The Thirring model with repulsive interaction is analyzed with some sufficiently general auxiliary condition. It is shown that for determination of free energy, two-time correlation functions, and Green's functions, the contribution of pair positive interaction becomes negligible for the large system. (auth)

1062 (ITF-71-70-P) MOTION OF A RIGID NONROTATING BODY IN RELATIVITY THEORY AND THE FERMI TRANSFER. Evtushenko, S. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

A rigid nonrotational Born-type motion in special relativity is defined in terms of the notion of "supporting" trajectory. It is shown that if one is given a trajectory of some point of the body, then all the remaining points of the body will be at rest with respect to the Fermi frame of reference transferred along the given trajectory. A generalization of this definition in general relativity is presented and the conditions under which the new definition coincides with the Born definition of rigidity are indicated. (auth)

1063 (ITF-71-71-P) MOTION OF A RIGID ROTATING BODY IN SPECIAL RELATIVITY. Evtushenko, S. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown on the basis of the Herglotz classification that a rigid rotational Born-type motion in special relativity represents a usual motion relative to the Fermi frame of reference, transferred along the trajectory of an arbitrarily chosen point of the body. A discussion is given of the restrictions imposed on the motion, and the possibilities of generalizing the definition of rigidity are considered. (auth)

1064 (ITF-71-83-E) GENERALIZED WARD IDENTITIES FOR GAUGE FIELDS. Slavnov, A. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 14p. Dep. NTIS (U. S. Sales Only).

In the gauge theories of the massless Yang–Mills type the generalized Ward–Takanashi identities are derived. All ultraviolet divergencies are shown to be removed by means of the coupling constant and wave function renormalization. (auth)

1065 (NP-19032) ON A DIFFERENTIAL EQUATION APPROACH TO QUANTUM FIELD THEORY: CAUSALITY PROPERTY FOR THE SOLUTIONS OF THIRRING'S MODEL. Note No. 309. de Mottoni, P.; Salusti, E. (Rome Univ. (Italy). Istituto di Fisica). 31 Mar 1971. 15p. Dep. NTIS (U. S. Sales Only).

A causality property is established for the solutions of Thirring's model, where the "fields" are operator-valued functions of the space-time variables. This property is just what one expects for the convolution of a Wightman field with a compactly supported C^∞ function. (auth)

1066 (NYO-3829-74) QUANTUM THEORY OF PARTICLES WITH SPIN ZERO AND ONE HALF IN EXTERNAL FIELDS. Seiler, R. (Pittsburgh Univ., Pa. Dept. of Physics). Aug 1971. Contract AT(30-1)-3829. 37p. Dep. NTIS.

The classical theory for spin-0 and -½ particles in an external field is reviewed to the extent necessary for quantization. Two models are considered. (J.F.P.)

1067 (NYO-3829-77) NECESSARY AND SUFFICIENT CONDITION FOR THE SOFTNESS OF THE TRACE OF THE ENERGY-MOMENTUM TENSOR. Schroer, Bert (Pittsburgh Univ., Pa. Dept. of Physics). Sep 1971. Contract AT(30-1)-3829. 10p. Dep. NTIS.

It is shown in a direct fashion that the asymptotic softness for the trace of the correct renormalized energy momentum tensor is equivalent with the coupling constant being equal to a Gell-Mann Low eigenvalue. From the softness of the trace one obtains the asymptotic conformal invariance at the Gell-Mann Low eigenvalue. For coupling constants different from this special value one only obtains the softness of the integral over the trace which leads just to asymptotic dilatation invariance. (auth)

1068 (ORO-3992-67) ON THE STABILITY OF CLASSICAL FREE, CHARGED TACHYON, AND CERENKOV RADIATION. Chiang, C. C. (Texas Univ., Austin. Center for Particle Theory). Sep 1971. 11p. (CPT-117). Dep. NTIS.

The classical picture of radiation mechanism for a charged particle and the Čerenkov radiation are discussed. It is concluded that a free charged tachyon does not emit radiation. The paradox that the velocity field energy of the charged tachyon is not constant can be resolved if one takes the total velocity field as the sum of half retarded and half advanced fields. (auth)

1069 INTERNAL REISSNER-WEYL SOLUTION. Kramer, D.; Neugebauer, G. (Univ., Jena, Ger.). Ann. Phys. (Leipzig); 27: No. 2, 129-35(1971). (In German).

With the aid of an invariance transformation of the Lagrangian a class of exact static solutions of the Einstein–Maxwell equations including perfect fluid is obtained. Application of the method to the interior and exterior Schwarzschild solution yields a corresponding solution with electromagnetic field (Reissner–Weyl solution). The boundary conditions of the resulting metric are automatically fulfilled. (auth)

1070 RENORMALIZATION OF RATIONAL LAGRANGIANS. Delbourgo, R.; Koller, K.; Salam, Abdus (Imperial Coll. of Science and Tech., London). Ann. Phys. (N. Y.); 66: No. 1, 1-19 (Jul 1971).

It is shown that rational Lagrangians of the type $G\phi^{\nu_0}(1+\lambda\phi)^{-\nu_1}$ can be renormalized by introducing a finite class of infinite counter terms providing that the Dyson index $\nu_0 - \nu_1 \leq 3$. The form of the counter terms is explicitly exhibited. The theories become unrenormalizable when $\nu_0 - \nu_1 > 3$; in particular, the case $\nu_0 - \nu_1 = 4$ is discussed which resembles a $g\phi^4$ theory for $\phi \to \infty$, and is nonrenormalizable, contrary to what one may have naively expected. (auth)

1071 C*-ALGEBRA APPROACH TO QUANTUM FIELD THEORY. Streater, R. F. (Inst. for Theoretical Physics, Lund, Sweden). Phys. Scr.; 3: No. 1, 5-7(1971).

A brief survey of the physical ideas behind the C*-algebra approach to quantum field theory, including internal symmetries, spontaneously broken symmetries, and the Haag–Kastler theory of the nature of charge is presented. It is illustrated with a model in two-dimensional space–time. (auth)

1072 TIME AND THE SPACE TRAVELLER. Marder, L. London; Allen and Unwin (1971). 210p. £3.25.

The subject is discussed under the following headings: background to relativity (the Michelson–Morley experiment, the invariable speed of light, measuring length and time, simultaneity and the synchronisation of clocks, the Lorentz transformation, moving rulers and clocks, Minkowski's four-dimensional space–time); the clock paradox; the problem of acceleration; matters of simultaneity; the Doppler effect and the k–calculus; when is a clock not a clock; the principle of impotence; special relativity, right or wrong?; the experimental evidence (before 1950, mesons, Moessbauer effect, use of artificial earth satellites); and the clock paradox in general relativity (the principle of equivalence). 305 references (UK)

1073 SOME THEORETICAL INVESTIGATIONS OF THE DOPPLER EFFECT IN THE SPECIAL THEORY OF RELATIVITY. Antonov, A. God., Sofii. Univ., Fiz. Fak.; 63: 73-82(1968-1969).

The validity of the Doppler effect equation is expanded not only for photons but for all material particles. It is suggested that each material particle is accompanied by a material object (called a kineton) which may be characterized by energy, momentum, frequency, mass and frequency vector. The properties of these objects are investigated. (J.F.P.)

Gravitation and General Relativity

Refer also to abstracts 697 and 702.

1074 (ITF-71-23-P) CONCEPTION OF A SINGLE OBSERVER AND ANTIOBSERVER IN DEFINING THE ENERGY IN A GENERAL RELATIVITY THEORY. Mitskevich, N. V.; Dias, A. A. Garcia (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

The standard formulation of the Nöet theorem is strictly scalar Lagrangian leads to the scalar conserving integral values (for energy, momentum and so on) i.e., to the conserving densities being the actual contravariant vector densities. The core of the problem lies in definition of the reference frame (the reference frame is represented by the tetrad field), which admits only the physical interpretation of the obtained conserving values. This is connected with inducing the generalized mobility of space-time (generalized Killing vectors) by any given tetrad field, independent of the presence of isometry in a usual sense. Along with the conception of single observer suggested previously, in a series of problems it is proposed to carry out the concrete gauging of tetrad field (establishing the global reference frame) on the basis of a new conception of antiobserver as well. This allows one to compare the results of the Einstein and the Newton gravitation theory in the energy aspect. The example of such a comparison is given on the basis of Schwartzschield field. (auth)

1075 (ITF-71-25-E) RECEIVING OF GRAVITATIONAL RADIATION FROM SOME EXTRATERRESTIAL SOURCES BY MEANS OF HETEROGENEOUS DETECTOR. Braginskii, V. B.; Nasarenko, V. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 10p. Dep. NTIS (U. S. Sales Only).

The interaction of a rotatory heterogeneous detector with gravitational radiation is estimated. It is indicated that such a kind of detector may be used for receiving the gravitational radiation from pulsars and double stars. (auth)

1076 (ITF-71-35-P) MACROSCOPIC QUANTUM OBJECTS AS GENERATORS AND DETECTORS OF GRAVITATIONAL WAVES. Kopvillem, U. Kh. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The properties of quantum systems consisting of a great number of particles which have an infinite discrete equidistant energy spectrum are considered. The possibility of using such systems for the reception and generation of gravitational waves is considered. In conclusion some new possibilities of searching for the working substances for gravitational physics are suggested, and the examples characterizing the state of experiment in development of gravitational devices on the basis of macroscopic objects are given. Some requirements of the detector of relic gravitational radiation are presented. (auth)

1077 (ITF-71-40-P) ON THE RELATIVISTIC DYNAMICS OF A TEST BODY. Pyrogas, K. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 29p. (In Russian). Dep. NTIS (U. S. Sales Only).

The construction is given of the covariant Hamiltonian formalism for a test particle in general relativity with an account of non-gravitational forces. Covariance is attained using covariant variational formalism. Use of the test-body eigentime and the isochronous correspondence of points on world lines appears essential. A generalization of the Jacobi method is given. The covariant equations in variations are derived which are analogous to the Poincare equations in variations for a classical dynamics. A notion of the stability of motion of a test body in the sense of Lyapunov is formulated covariantly. Some theorems concerning the covariant equations in variations are proved. (auth)

1078 DEBYE POTENTIALS FOR THE GRAVITATIONAL FIELD. Campbell, W. B. (Univ. of Nebraska, Lincoln); Morgan, T. Physica; 53: No. 2, 264-88(28 May 1971).

Debye potentials for the gravitational field of a bounded system are given. The field equations of the linearized theory of gravitation are written in a form very similar to Maxwell's equations using field strengths which are the components of the Weyl tensor. The Debye potentials are then closely related to the two nontransverse components E_{RR} and B_{RR}. These components completely determine the field in empty space and give a simple characterization of the field in terms of two scalar quantities. In order to express the remaining field strengths simply in terms of the Debye potentials, a toroidal and poloidal representation of symmetric, traceless, divergenceless, 3-dimensional tensor fields is developed. The spherical components of these tensor fields are given in terms of spin-harmonics. The Debye potentials' explicit dependence on the sources are given in terms of a multipole expansion and the general expression for the momentum loss of a bounded system due to gravitational radiation is calculated in terms of the multipole moments. The properties of the field in the near and far field zones are discussed. (auth)

1079 CONSTANCY OF PARTICLE NUMBERS IN GENERAL RELATIVITY THEORY. Treder, H.-J. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 27: No. 1, 47-56(1971). (In German).

It is suggested that the "spontaneous creation of matter in strong gravitation fields"—which was asserted previously—may be a result of an inconsistent approximation for the simultaneous systems of Einstein field equations and of matter field equations. Firstly it is remarked that Einstein's dynamical equation is not only the consequence of the Einstein field equations (via Bianchi identity) but also the consequence of the relativistic matter field equations and of the weak principle of equivalence. Therefore, for all discussions one must start from the dynamical equation and from the conservation laws of charges. Secondly, a formal inhomogeneous dynamical equation is found for the matter tensor by working in a background-field approximation. But, this inhomogeniety vanishes according to the matter field equations. Thirdly, the properties in an evolution-cosmos are discussed. In such cosmos a law of conformal conservation of energy is fulfilled. From this conservation law results that the energy is a continuous function of the gauge of time. Such continuous dependence involves the constancy of discrete numbers according to the well known argument of Planck. (auth)

1080 CRUCIAL TESTS OF GENERAL RELATIVITY. Arjun, Tan Tung (Visva-Bharati Univ., Santiniketan, India). Chin. J. Phys. (Taiwan); 9: No. 1, 29-30(Apr 1971).

The crucial tests of general relativity can no longer be regarded as exclusive tests of Einstein's theory. They may be derived from the application of special relativity, the equivalence principle and Newtonian results. They are also obtained on Yilmaz's theory. The precession of planetary orbits, long considered as the strongpoint of general relativity is given by two other theories of gravitation. (auth)

1081 WEIGHT OF LIGHT IN THE GRAVITATION THEORY. II. Treder, H.-J. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 27: No. 2, 177-81(1971). (In German).

If the vacuum velocity v of light is a function of the gravitation field only (Einstein-effect), then v is independent of the light frequency ν. This statement results from the Maxwell equations only and is independent of the special form of gravitation field theory. The frequency independence of the velocity of light is in a good agreement with astrophysical facts. However, in nonlinear generalizations of Maxwell's electrodynamics a hypothetical dependence of the light velocity on the intensity of the radiation field may result (Freundlich-effect). This hypothetical effect may give a dependence of v on the frequency. An excess in the red-shift of the solar spectral-lines should be associated with this excess of the light deflection. In the visual domain of the solar spectrum the real value of the red-shift could be more than 20% greater than the Einstein-value. (auth)

1082 FIELD THEORY ON CURVED SPACE TIME AND THE TCP THEOREM. Flato, Moshe; Simon, Jacques (Royal Inst. of Tech., Stockholm). Phys. Scr.; 3: No. 2, 53-4(1971).

A generalization is given to the Wightman axioms of field theory which permits one to treat the gravitational field as a Wightman field. This generalization permits one to deduce the ICP theorem for the gravitational field. Some critical remarks concerning the physical interpretation of the TCP theorem are made. (auth)

Scattering Theory

Refer also to abstracts 1016 and 1058.

1083 (ITF-71-62-E) REMOVAL OF MULTIFOLD POLES IN DUAL AMPLITUDES WITH MANDELSTAM ANALYTICITY. Ferdman, R. E.; Enkovski, L. L.; Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 7p. Dep. NTIS (U. S. Sales Only).

A mechanism is suggested which removes multifold poles in dual models with Mandelstam analyticity. The explicit form of a dual, crossing symmetric amplitude satisfying a dispersion relation is given; the amplitude is free of ancestors and multifold poles. (auth)

1084 EXPONENTIALLY SMALL SCATTERING AMPLITUDE IN HIGH ENERGY POTENTIAL SCATTERING. Paliov, A.; Rosen-

dorff, S. (Technion-Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.); 66: No. 1, 189-217(Jul 1971).

The high-energy scattering amplitude of spherical symmetric potentials, which are expandable in ascending even powers of r and are nonsingular in coordinate space, is calculated. The Gaussian potential, which serves as a prototype of these potentials, is dealt with extensively. The first Born approximation is completely inadequate to estimate the amplitude off the forward direction. It is shown that the amplitude decreases faster than any power law as function of the momentum transfer, q, and thus in that respect is similar in behavior to that of elastic scattering of elementary particles. Essentially, the whole range of the scattering angle is covered. Some speculations concerning shrinkage and antishrinkage effects are briefly mentioned. (auth)

1085 TEST OF A LEAST-SQUARES VARIATIONAL METHOD FOR NON-RELATIVISTIC SCATTERING. Schmid, E. W.; Hoffmann, K. H. (Univ., Tuebingen, Ger.). Nucl. Phys.; A175: No. 2, 443-8(1971).

The influence of weight factors in a least-squares method for the nonrelativistic scattering problem is investigated in a one-channel test example. Weight factors seem to be unimportant over a wide range of values, which justifies certain reductions of the dimension of equations and allows the use of linear equations instead of eigenvalue equations. (auth)

Particle Accelerators

Refer also to abstracts 1174, 1252, and 1331.

1086 (BARC/I–81) SUMMARY OF SHIELDING CALCULATIONS FOR THE PROPOSED VARIABLE ENERGY CYCLOTRON AT CALCUTTA. Muthukrishnan, G.; Singh, Hari (Bhabha Atomic Research Centre, Bombay (India)). 1970. 9p. INIS.

Shielding calculations for neutrons due to the bombardment of 65 MeV deuterons on beryllium and 135 MeV alphas on tantalum are considered for the Variable Energy Cyclotron (VEC) proposed to be constructed at Calcutta. Neutron fluxes are calculated with the present concrete shields. Suitable shield thicknesses, to reduce the neutron flux outside the shield to the tolerance dose of 17 neutrons/cm^2/sec and also to 1.7 neutrons/cm^2/sec., are recommended. (INIS)

1087 (BMBW-FBK–71-9) FIRST BIENNIAL REPORT, 1968/1969. Eichner, H.; Gonsior, B.; Gruhle, W.; Klein, H.; Schimmer, B. (Cologne Univ. (West Germany). Institut fuer Kernphysik). Aug 1971. 128p. (In German). Dep. NTIS (U. S. Sales Only).

The first 2-years report describes the installation and performance of the Cologne Tandem Accelerator, including the facilities of the institute (computer, target and detector laboratory). The experiments cover the field of nuclear reactions including particle reactions, Coulomb excitation, excitation functions, isobaric analog states, threshold measurements and various experiments in nuclear spectroscopy. (auth)

1088 (BNL–16186) COMPARISON OF HIGH-FIELD BENDING MAGNETS BASED ON THE SEXTUPOLE CORRECTIONS REQUIRED. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 7 Sep 1971. 7p. Dep. NTIS.

A comparison is made of three bending magnets, based on the requirements of the sextupole correction coil. The three magnets considered are the cosine magnet, the H-magnet, and the window-frame magnet. A comparison is made of the stored energy associated with the sextupole correction coil and the current required by the sextupole coil. The results of the comparison particularly favor the cosine magnet. (auth)

1089 (BNL–16212) PROPOSED TOLERANCE ON MAGNETIC FIELD NONLINEARITIES IN HIGH ENERGY STORAGE RINGS. Parzen, G. (Brookhaven National Lab., Upton, N. Y.). 4 Oct 1971. 7p. Dep. NTIS.

The problem of tolerances on magnetic field nonlinearities in storage rings with long beam lifetimes is considered. The nonlinearities present in the CERN storage rings are reviewed. Possible effects of nonlinearities are discussed. A tentative tolerance is suggested on nonlinearities in the magnetic field. The effects of nonlinearities introduced by random errors in the magnet are also considered. (auth)

1090 (CERN-Trans–71-30) DAMPING OF THE EFFECT OF THE INCREASE OF BEAM DIMENSIONS DUE TO THE INFLUENCE OF NON-LINEAR RESONANCES AT THE IHEP ACCELERATOR. Gridasov, V. I.; Myznikov, K. P.; Chepegin, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Translated by A. T. Sanders (CERN, Geneva, Switzerland), from report IFVE-SKU–70-90. 12p. Dep. NTIS (U. S. Sales Only).

The increased dimensions of the extracted proton beam from the Serpukhov Synchrotron were studied. The dependence of the beam dimensions on the value of the magnetic field of the accelerator, the dependence of the frequencies of the betatron oscillations on the radial position of the beam, and the dependence of the beam dimensions on the radial position of the beam during the flat top of the magnetic cycle are presented graphically. It is concluded that the main reason for the increase of the beam dimensions is the effect of nonlinear resonances, and correction procedures are outlined. (W.H.K.)

1091 (CERN-Trans–71-31) MEASUREMENT OF THE FREQUENCIES OF BETATRON OSCILLATIONS AT THE IHEP ACCELERATOR AT MEDIUM AND HIGH ENERGIES. Gertsev, K. F.; Gridasov, V. I.; Kuz'min, A. A.; Myznikov, K. P.; Senatorov, G. F. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii. Translated by A. T. Sanders (CERN, Geneva, Switzerland), from report IFVE-SKU–70-86. 16p. Dep. NTIS (U. S. Sales Only).

The frequencies of the betatron oscillations were measured by two different methods in medium and high fields. The first method used the dependence of the relative displacement of the closed orbit, when there is local perturbation of the magnetic field, on the frequency of the betatron oscillations. The second method was based on the resonant excitation of coherent betatron oscillations. The measuring equipment is described and results are presented. (W.H.K.)

1092 (FEI–211) THE 30-MeV MICROTRON OF THE PHYSICO-ENERGETIC INSTITUTE. Abramov, A. I.; Ankin, G. N.; Vasin, V. T.; Klintsov, N. A.; Stavisskii, Yu. Ya.; Filyaev, V. F.; Choporov, Yu. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1970. 21p. (In Russian). INIS.

A brief description of the microtron and some initial results of experience with it are given. Data on the first physical experiments conducted with the microtron in 1969 are included. (tr-INIS).

1093 (JINR–P9-6003) SOME PROBLEMS IN THE CONSTRUCTION OF A COLLECTIVE ACCELERATOR (KOL'TSETRON). Derendyaev, Yu.; Ivanov, I. N.; Iovnovich, M. L.; Kaminskii, A. K.; Mironov, V. I.; Preizendorf, V. A.; Rubin, N. B.; Sarantsev, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The formation of a magnetic field for focusing and accelerating the electron-ion ring in a collective accelerator is studied. Tolerance requirements are obtained for the magnetic field of the primary section of the accelerating system. The effects of ion accumulation on the formation of the ring are examined. Design problems in connection with the required electron ring for the collective accelerator are considered in the case where the magnetic field is constant with respect to time. (tr-auth)

1094 (JINR–P9-6062) ACCELERATION OF THE Xe IONS IN THE JINR CYCLOTRONS. Shelaev, I. A.; Alfeev, V. S.; Zager, V. A.; Kozlov, S. I.; Kolesov, I. V.; Linev, A. F.; Mel'nikov, V. N.; Oganesyan, R. Ts.; Oganesyan, Yu. Ts.; Chugreev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

An accelerating system is described consisting of 2 cyclotrons — of 2 and 3 meters — with the help of which Xe ion beams of about 7 MeV/N will be obtained. (auth)

1095 (LNF–71/15) CALCULATIONS ON THE TRAJECTORY OF ELECTRONS IN AN ADONE MAGNET USED AS A MOMENTUM ANALYZER. Vignola, G. (Comitato Nazional per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 29 Apr 1971. 7p. (In Italian). Dep. NTIS (U. S. Sales Only).

Some experimental groups at Adone use the magnets of the machine as momentum analyzers for the electrons which, after an interaction, have lost part of their energy. This problem was examined from the magnetic optical viewpoint. The problem was formulated as an electron with pulse p_e leaves at an angle from the center of the right section at a given distance from the equilibrium orbit. The angle at which the electron will enter a detector placed in the magnet at a given distance from the equilibrium orbit is calculated. The effects of the magnets and the quadrupoles are calculated separately and added. (J.S.R.)

1096 (ORNL–TM–3437) NUCLEON AND CHARGED-PION ALBEDO SPECTRA IN AN ACCELERATOR CAVE FROM 200-GeV PROTON INTERACTIONS IN IRON. Gabriel, T. A.; Santoro,

R. T. (Oak Ridge National Lab., Tenn.). 27 Aug 1971. Contract W-7405-eng-26. 41p. Dep. NTIS.

Nucleon and charged-pion albedo flux distributions in an accelerator cave resulting from the interaction of 200-GeV protons have been calculated. The spectra are given as a function of secondary-particle energy and of radial position and distance from the point where the beam is dumped into the iron. Comparisons between the omnidirectional and "backward" flux distributions are presented. (auth)

1097 (RPP/A-85) COMPUTER CONTROLS: STATE OF THE ART AND FUTURE DEVELOPMENTS. Hyman, J. T. (Rutherford High Energy Lab., Chilton (England)). Sep 1971. 6p. (CONF-710908-2). Dep. NTIS (U. S. Sales Only).

From eighth international conference on high energy accelerators; Geneva, Switzerland (20 Sep 1971).

A review of the current state of the accelerator computer control art is presented and a number of interesting new developments highlighted. An attempt is made to indicate future lines of development in the next few years. (auth)

1098 (SLAC-139) DESCRIPTION AND PHYSICS PROGRAM OF THE PROPOSED RECIRCULATING LINEAR ACCELERATOR (RLA). (Stanford Linear Accelerator Center, Calif.). Sep 1971. Contract AT(04-3)-515. 79p. Dep. NTIS.

A method of approximately doubling the energy of the SLAC Accelerator by recirculation of the beam and reinjection into the machine for a second pass is described. The recirculator could also be used for high duty cycle (up to 6%) experiments at the recirculating energy by storing the beam and extracting about 1% of the electrons per revolution. Recirculation will initially occur at an energy of 17.5 GeV. Beam losses of ~125 MeV due to synchrotron radiation would be compensated by 2 sectors (666 ft) of standard accelerator sections operating at the accelerator frequency (2856 MHz). These sectors will be pulsed at a repetition rate of 43,500 pulses per second corresponding to the recirculating period of about 23 microseconds. The beam will be stored for 2.8 milliseconds (approximately 122 revolutions around the 6900 meter storage path); this is the time interval between the normal pulses of the accelerator. Using this method, the energy of the SLAC accelerator could be increased initially to about 42.5 GeV. The recirculator is designed to permit later increase of the storage energy to 25 GeV by the use of superconducting accelerator sections to restore the synchrotron energy loss. Then, assuming that a proposed program to replace the present 30 MW klystrons powering the accelerator with 60 MW models has been completed, the maximum beam energy would become 60 GeV. Upon completion of the proposed recirculation system the increased beam energy and duty cycle will greatly enhance its utility in particle physics research. A discussion of some of the physics opportunities which would become available is given. (auth)

1099 (TRI-71-3) CONCEPTUAL DESIGN OF THE TRIUMF THERMAL NEUTRON FACILITY. Thorson, I. M.; Arrott, A. S. (TRI-Univ. Meson Facility, Vancouver (British Columbia)). Jul 1971. 96p. Dep. NTIS (U. S. Sales Only).

The conceptual design of the proposed thermal neutron facility (TNF) based on the neutron source produced by dumping the residual beam from the main TRIUMF proton beam line into a high atomic weight target is described. The maximum useful thermal neutron flux in a water-reflected, 120 cm dia heavy-water-graphite moderator assembly surrounding a 15 cm dia Pb–Bi target is $\sim 0.9 \times 10^{13}$ cm^{-2} sec^{-1} at 50 kW residual beam power; this figure is higher by a factor of ~2.5 for a natural uranium target. The neutron irradiation and beam tube facilities are described as well as facilities for carrying out proton beam irradiations. Heat dissipation and residual activity problems are discussed and a preliminary cost estimate is given. The total estimated cost, without any contingency allowance, is $434,000, of which 60% is for shielding. (auth)

1100 (UCRL-20452) 3-MeV INJECTOR FOR THE SUPERHILAC. Spence, D. A.; Gavin, B. F.; Peters, R.; Reginato, L. L.; Smith, B. H.; Wolgast, R. C. (California Univ., Berkeley. Lawrence Radiation Lab.). Jun 1971. Contract W-7405-eng-48. 44p. (CONF-710308-30). Dep. NTIS.

From National particle accelerator conference; Chicago, Ill. (1 Mar 1971).

The design and performance of a shunt-fed Cockcroft–Walton injector for the SuperHilac are described. The injector uses silicon diodes in its voltage multiplier operating at 100 kHz and accelerates multiply-charged heavy ions with charge-to-mass ratios between 0.042 and 0.09. Peak heavy-ion currents of 15 mA at duty factors up to 50% can be supplied. The design and performance of the Penning-type ion source are also described. (W.H.K.)

1101 LINEAR ACCELERATOR WITH VARIABLE ENERGY. Bomko, V. A.; Klyucharev, A. P.; Rudyak, B. I. At. Energ. (USSR); 31: No. 2, 123-6(Aug 1971). (In Russian).

A new method of producing beams with energy variation in linear accelerators is described. A smooth energy variation is achieved by forming a uniform space of the accelerating field with sharp attenuation using the E_{011} mode wave. Experimental results for a 9 MeV proton linear accelerator are presented. It is shown that any intermediate energy can be achieved without any loss of intensity and with approximately constant energy width of the beam. (auth)

1102 DYNAMICS OF COLLIDING CHARGED BUNCHES IN IMPACT ACCELERATION. Bonch-Osmolovskii, A. G. At. Energ. (USSR); 31: No. 2, 127-31(Aug 1971). (In Russian).

Some questions on the dynamics of colliding charged relativistic bunches of particles in impact acceleration, proposed by V. I. Veksler, are considered. The effects of radiation and parameter changes of the bunches during collision at distances larger than the dimensions of the bunches are estimated. Conditions for effective acceleration of light electron bunches containing ions are established. (auth)

1103 LONGITUDINAL STABILITY OF A BEAM IN LINEAR INDUCTIVE SYSTEMS. Grishin, V. K. At. Energ. (USSR); 31: No. 2, 163-4(Aug 1971). (In Russian).

Linear inductive accelerators offer simplicity and accuracy and find wide application in the production of accelerated particle beams. At large currents, however, longitudinal instability of the beam appears, disrupting its homogeneity. A linear inductive accelerating system is usually a collection of ring-shaped inductors with a ferromagnetic core. Accordingly particles move in a ferromagnetic channel where the magnetic permeability is $\gg 1$. In this study an infinite system of ring-shaped inductors of a linear inductive accelerating system was examined. It is shown that the instability is developed at a distance of several meters. This is discussed further with regard to considerations of losses in the core, beam excitation, and other factors which may disrupt the energy homogeneity of the particles. (K.S.W.)

1104 ABSOLUTE MEASUREMENT OF BEAM INTENSITIES BY THE FLUCTUATION METHOD. Lyakhno, Yu. P.; Nikitin, V. A. At. Energ. (USSR); 31: No. 2, 164-5(Aug 1971). (In Russian).

The number of particles being generated on a thin target by a stable particle beam from a pulsed accelerator fluctuates near an average value in accordance with Poisson's law. The number of secondary particles makes it possible to make absolute measurements of beam intensities with the aid of a detector and without the necessity of calibration. The intensity of these beams may exceed the performance of particle counters at a point where the intensity should be measured by integrating apparatus such as a calorimeter or Faraday apparatus. The method described may be used for measuring the intensity of bremsstrahlung with bubble chambers (~300 photons/impulse). Radiation beams >500 photons/impulse were measured with a thick-walled ionization chamber. Results of both methods agree within 15%. (K.S.W.)

1105 POSSIBILITY OF USE OF IONIZATION FRICTION FOR HEAVY PARTICLE STORAGE. Ado, Yu. M.; Balbekov, V. I. At. Energ. (USSR); 31: No. 1, 40-4(Jul 1971). (In Russian).

Attenuation of betatron and synchrotron oscillations is ascribed to A. A. Kolomenskii's "ionization friction". Mathematical treatments of oscillation decrements and dimensions of the particle beam were undertaken. Particle loss resulting from single-stage processes is discussed, and graphs demonstrate the "cross section of ionization friction" in the interaction of protons with hydrogen. (K.S.W.)

1106 HIGH-CURRENT CW-MODE LINEAR PROTON ACCELERATOR. Shembel, B. K.; Komar, E. G.; Fedotov, A. P.; (and others). At. Energ. (USSR); 31: No. 1, 45-9(Jul 1971). (In Russian).

Some results obtained when starting a high-current GW-mode linear proton accelerator are presented. Main parameters of the linac are as follows: injection energy between 85 and 100 keV, output energy between 500 and 600 keV, accelerated proton current 250 mA, and operating frequency 24 Mc. Characteristics of longitudinal motion have been studied and some features of this high-power accelerator are described. (auth)

1107 SUPERCONDUCTING MAGNETIC QUADRUPOLAR LENS. Goncharenko, I. I.; Sidorenko, I. S.; Revutskii, E. I. At. Energ. (USSR); 31: No. 1, 71-2(Jul 1971). (In Russian).

A compactly constructed magnetic quadrupole lens with coils of superconducting material was assembled in order to provide

an intense magnetic field with minimum loss of Joule heat. The maximum field generated was 11,400 oersteds, corresponding to 9,700 ampere-turns per pole. (K.S.W.)

1108 ELECTRON ACCELERATOR. Epsztein, Bernard; Pinel, Jacques (to CSF-Compagnie Generale de Telegraphie Sans Fil). German Patent 1,809,899. 28 Aug 1969. Priority date 21 Nov 1967, France. (In German).

An electron accelerator characterized by an arrangement of n cavity resonators connected in series with each other for the propagation of an electron beam is described. The electron source and injection system are described. There are devices for the repeated propagation of the beam along various straight-line parallel paths. High-frequency energy is introduced into the accelerator. (J.S.R.)

1109 BEHAVIOR UNDER SPACE CHARGE CONDITIONS OF A CHARGED PARTICLE BEAM IN A CONSTANT LONGITUDINAL MAGNETIC FIELD. Roux, Catherine; Tanguy, Pierre (Rennes Univ., France). Compt. Rend., Ser. B; 272: No. 25, 1406-9(21 Jun 1971). (In French).

The radius of the envelope of a beam with a uniform charge density over any normal cross section is calculated for a constant longitudinal magnetic field. The fact that the beam emittance is nonzero is considered. (France)

1110 RELEVANCE OF PARTICLE ACCELERATORS TO NATIONAL GOALS. Rosen, Louis (Los Alamos Scientific Lab., N. Mex.). Science; 173: No. 3996, 490-7(6 Aug 1971).

The relationship of accelerators to national goals, inventory of particle accelerators, role of particle accelerators in industry, nondestructive testing, radioisotope production, power reactor applications, radiation processing, the role of accelerators in defense, and accelerators for medical purposes are briefly discussed. (W.H.K.)

1111 MICROTRON WITH A POLYGONAL PATH. Leboutet, Hubert (to Thomson-CSF). French Patent 2,040,598. 11 Jan 1971. Filed 4 Apr 1969. (In French).

A closed circuit particle accelerator consisting of a particle injector device, a linear portion of the circuit in which the accelerating energy is applied to the particles, and one or several tubular enclosures joining respectively the input and output of the linear portion is described. The enclosure is provided with devices for magnetically guiding and focusing the particles in plane polygonal trajectories. (France)

1112 ELECTRON BEAM SCANNING DEVICE. Girard, Francois; Leboutet, Hubert (to Thomson CSF). French Patent 2,045,049. 15 Feb 1971. Filed 30 May 1969. (In French).

A method for overcoming the inconveniences caused by the density variations encountered at the extremities of the sweep of an electron beam in scanning devices used in radiography and irradiation equipment is described. Two electromagnetic assemblies placed at different positions along the beam path are used to displace the beam: the first introduces a displacement varying cyclically with time, and the second, a displacement in the opposite sense to the first, but dependent on the original displacement. (France)

1113 IMPROVEMENTS TO GRADIENT MAGNETS. Aucouturier, Jeanne; Lacaze, Rene (to Thomson-CSF). French Patent 2,043,973. 8 Feb 1971. Filed 5 May 1969. (In French).

The device used with the accelerators or in gammagraphy for guiding or focusing the particle beams is described. It consists of a magnetic divertor for beams of electrically charged particles. A magnetic field is generated between two pole pieces that determine the gap through which the beams pass. The device consists of two pairs of terminal faces at each end. The faces of at least one of these pairs are supplied with ferromagnetic metallic pads able to hinge upon axes perpendicular to the faces. (France)

1114 ION SOURCE USING SURFACE IONIZATION PHENOMENA. Felden, Marceau; Remy, Michel (to Commissariat a l'Energie Atomique). French Patent 2,045,097. 15 Feb 1971. Filed 30 May 1969. (In French).

A Li ion source using the surface ionization phenomena occurring on a hot surface is presented. The source is intended for the production of the plasma source of an accelerator or a thermonuclear fusion device. It includes refractory capillary tubes, a Li reservoir, a system for heating the reservoir and the capillaries and means of Li ion extraction. Each refractory tube contains several wires arranged in a ring, made of a refractory metal with a work function of the same order of magnitude as the Li ionization potential. (France)

1115 PARAMETRIC ACCELERATION IN CROSSED FIELDS. Sokolov, A. A.; Kul'kin, A. G.; Pavlenko, Yu. G. At. Energ. (USSR); 31: No. 3, 292-4(Sep 1971). (In Russian).

Several mechanisms for accelerating charged particles are theoretically examined, using the phenomenon of parametric resonance. The equations show, for example, how long it requires a proton to achieve a given energy, having accomplished a given number of revolutions. In conclusion it is stated that if singly charged ions of light elements are accelerated, ($A \sim 10$), then the corresponding energy value will be 100 keV. (K.S.W.)

1116 EFFECT OF BEAM LOADING ON PARAMETERS OF THE ACCELERATING SYSTEMS OF ELECTRON CYCLIC ACCELERATORS IN STEADY-STATE REGIME AND WITH INJECTION. Didenko, A. N.; Fomenko, G. P. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 74-80 (1969). (In Russian).

Matching conditions of the accelerating system of an accelerator and an expression for the initial resistance of the resonator are obtained with calculation of the loading of the electron beam in the steady state. It is shown that the effect of beam loading during electron capture leads to a frequency shift of the high-frequency field, as a result of which the current can be substantially decreased. (tr-auth)

1117 CONVERSION OF LONG RIBBON BEAMS OF CHARGED PARTICLES INTO CYLINDRICAL BEAMS. Sveshnikov, A. G.; Semashko, N. N.; Khapaev, M. M. (Moscow State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 595-8(Oct 1971).
Translated from Zh. Tekh. Fiz.; 41: No. 4, 760-4(Apr 1971).

A method of converting long ribbon beams of charged particles into cylindrical beams is described. A cyclotron-type magnetic field is used in which the particles are emitted radially in the median plane. The focusing properties of this system are determined by investigating the trajectories of the charged particles. (auth)

1118 ELECTRON TRAPPING IN A BETATRON. Ivanov, D. P.; Komar, A. P.; Korobochko, Yu. S. (Leningrad Polytechnic Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 603-4 (Oct 1971).
Translated from Zh. Tekh. Fiz.; 41: No. 4, 770-1(Apr 1971).

The optimum injection current at which a maximum output of γ rays is obtained is examined on the basis of the nonmonotonic dependence of the circulating current on the injection current. (auth)

1119 MONOCHROMATIZATION OF THE BEAM IN A 2-GeV ELECTRON LINEAR ACCELERATOR USING THE DEBUNCHING PROPERTIES OF THE SHAPING SYSTEM. Dovbnya, A. N.; Petrenko, V. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 608-9(Oct 1971).
Translated from Zh. Tekh. Fiz.; 41: No. 4, 776-8(Apr 1971).

The isochronous properties of the beam shaping system at the output of an electron linear accelerator are studied. It is shown that the system has debunching properties; as a result, the phase position of the particles in a bunch is a function of energy. This property of the system leads to an increase in the current duty factor and makes it possible to reduce the energy spread of the particles in the beam by a factor of five or more without loss in intensity. (auth)

1120 LONGITUDINAL BUNCH COMPRESSION. Grishaev, I. A.; Dovbnya, A. N.; Petrenko, V. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 610-12(Oct 1971).
Translated from Zh. Tekh. Fiz.; 41: No. 4, 779-82(Apr 1971).

A method is presented for obtaining relativistic electron bunches. High-frequency transverse fields are used to couple the phase of a particle to the radial and angular characteristics, and the coupling is used to produce nonisochronous motion in a longitudinal magnetic field. This method yields a phase-compression coefficient of 10 to 20 at 5 MeV. Factors that limit the phase spread to 1° are discussed. (auth)

1121 BEAM OPTICS IN THE 2-GeV MULTISECTION LINEAR ELECTRON ACCELERATOR. Grishaev, I. A.; Gugel, I. N.; Dovbnya, A. N.; Mocheshnikov, N. I.; Petrenko, V. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 613-16(Oct 1971).
Translated from Zh. Tekh. Fiz.; 41: No. 4, 783-7(Apr 1971).

Beam optics in a multisection electron accelerator built at the Physicotechnical Institute of the Academy of Sciences of the Ukrainian SSR (FTI AN UkrSSR) is described. The effect of static perturbations on the parameters of the accelerated beam (energy spectrum, energy, emittance, phase width of bunch) is discussed. It is shown that the accelerator exhibits the property of phase separation of particles, so that the trajectories of electrons with

different initial phases become separated in space, and the effective output emittance is greater than the initial value. The possibility of utilizing these properties to reduce the phase range of the bunch is discussed. The effect of amplitude-phase fluctuations on the parameters of the accelerated beam is also discussed. The solution of these problems is presented for the standard accelerator operating mode with accelerated electrons of 1 GeV. Current loading and hybrid oscillations are neglected. (auth)

1122 DESIGN OF A STRUCTURE WITH AN ALTERNATING-SIGN ACCELERATING FIELD ($\pi/2$ MODE). Andreev, V. G. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 617-23(Oct 1971).

Translated from Zh. Tekh. Fiz.; 41: No. 4, 788-96(Apr 1971).

A simple and exact method for calculating the geometric dimensions of an accelerating structure for a 150 to 200 MeV (or higher) linear proton accelerator is considered. The accelerating field in the $\pi/2$ mode alternates in sign, and the dispersion relation is linear and symmetric. The method used in the calculations, based on the theory of the electromagnetic field, can be used to find the best accelerating structure of this type. (auth)

1123 ANAMORPHIC ELECTROSTATIC LENS. Moroz, E. M.; Pisarev, V. E.; Solov'ev, N. S. (Lebedev inst. of Physics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 4, 664-5(Oct 1971).

Translated from Zh. Tekh. Fiz.; 41: No. 4, 841-3(Apr 1971).

An electrostatic lens with a grounded metal rod placed along the axis of the lens is studied. It is shown that the rod makes it possible to increase the focusing of the beam by using a transverse electrostatic field and the interaction of the electron beam with the charge induced on the rod. This increases the focused beam current by a factor of from three to five. (auth)

1124 CYCLOTRON-PRODUCED 54-MeV ^{3}He IONS. Irisbaev, K. N.; Uzakov, Ya. M.; Kurganov, B. G.; (and others) (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 9, 27-8(1970). (In Russian).

Using an accelerating field frequency of 14.02 MHz, and a voltage difference between the cyclotron dees of 210 to 220 kV, He-3 ions were accelerated to an energy of 54 MeV in a U-150-2 cyclotron. Beam current is plotted as a function of radius. (K.S.W.)

1125 ELECTROSTATIC DEFLECTION SWITCHING UNIT FOR MeV PARTICLE BEAMS. Pooley, D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., E (London); 4: No. 11, 909-12(Nov 1971)..

The design of an electronic drive unit with which the voltage across electrostatic deflection plates can rapidly be switched from several hundred volts to zero and vice versa is discussed. The resulting deflection system is intended for switching beams of electrons or positive particles with energies of the order of a few MeV. The deflector positions the beam on either an iris or a metal stop. Switching times of less than 10 ns in both on and off directions are achieved, and pulse lengths can be extended indefinitely from less than 10 ns. The drive unit has a pseudo-balanced configuration, reducing the power requirement to a few watts and allowing control by standard logic levels. (auth)

1126 ENERGY REGULATION OF THE ION BEAM OF THE U-120 CYCLOTRON. Kuzmiak, Mikulas; Kult, Karel (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 17: No. 8, 269-70(Aug 1971). (In Czech).

The trajectory of the ion output of a cyclotron was studied by means of thin foils after charge exchange (H^-, H^+). The energy change was determined for beam output in a given direction. The boundary field was represented by an analytical expression. (tr-auth)

1127 PRINCETON–PENNSYLVANIA ACCELERATOR: END OF AN ERA IN PARTICLE PHYSICS. Teter, D. Park. Science; 173: No. 3991, 36-9(2 Jul 1971).

Economic and scientific aspects of the shutdown of the Princeton– Pennsylvania Accelerator are discussed. (W.H.K.)

1128 COLLECTIVE ACCELERATION OF IONS. Ivanov, I. N.; Kuznetsov, A. B.; Perel'shtein, E. A.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). pp 391-442 of Problemy Fiziki Elementarnykh Chastits i Atomnogo Yadra. Tom 1, Vypusk 2. /Bogolyubov, N. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The collective method of acceleration of ions is described. The problem of electron ring creation with ions, stability, focussing and some questions of acceleration are discussed. (72 references) (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 357, 1099, 1157, 1199, 1245, 1263, 1563, 1603, 1637–1644, 1648, 1649, and 1655.

1129 (CONF-710301–(Vol.1), pp 98-105) INTEGRAL TEST OF INELASTIC SCATTERING CROSS SECTIONS USING MEASURED NEUTRON SPECTRA FROM THICK SHELLS OF Ta, W, Mo, AND Be. Shook, D. F.; Fieno, D.; Ford, C. H.; Alexander, R. L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Measured and calculated sphere leakage spectra in the energy range 0.5 to 11 MeV are used as a test of the accuracy of existing ENDF/B cross sections. Inelastic reactions are the primary cause of the large shift in the source spectrum as it traverses the spherical shell. A 50 Ci AmBe source was used as a source of fast neutrons at the center of 22 cm diameter spheres. The leakage spectra were measured at a distance of several hundred cm using an NE213 liquid scintillator neutron spectrometer. Room scattered neutron backgrounds were accounted for using a shadow cone. The spectra were calculated with 51 groups using ENDF/B and other cross sections and an S_n discrete ordinate transport code. The sensitivity of the leakage spectra to small changes in the cross sections has been calculated. A comparison between the calculated and measured spectra for Mo shows general agreement, but significant discrepancies are observed for W, Ta, and Be. (auth)

1130 (CONF-710301–(Vol.1), pp 332-47) NUMERIC DATA LIBRARIES OF THE NATIONAL NEUTRON CROSS SECTION CENTER. Goldberg, Murrey D. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The two primary responsibilities of the NNCSC are (1) to collect, organize, and disseminate the numeric results of neutron physics experiments from all over the world and (2) to oversee, collect, and disseminate an organized numeric library of evaluations of the interactions of neutrons with materials of importance in the nuclear energy program. To fulfill these responsibilities, two computer-based systems have been developed. CSISRS (Cross Section Information Stor- and Retrieval System) is a new highly flexible library of numeric experimental data, with associated alphanumeric information, compatible with EXFOR, the exchange format which ties together the data collection activities of a worldwide network of data centers. ENDF (Evaluated Nuclear Data File) provides a consistent format for the presentation and utilization of a set of uniform critical evaluations. The characteristics of these systems, the rationale behind them, and their uses within the neutron physics community will be discussed, with particular emphasis on CSISRS. (auth)

1131 (CONF-710301–(Vol.1), pp 348-53) DEVELOPMENT OF THE ENDF/B SYSTEM. Hemmig, P. B. (Division of Reactor Development and Technology (AEC), Washington, D. C. Reactor Physics Branch).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A prime objective in the development of the ENDF/B system is to achieve a closer coupling of measurement efforts, evaluation efforts, and data testing efforts to the needs of the reactor designers and operators. This has been achieved in part by using the standard "language" of the ENDF/B system (e.g., standard formats, procedures, graphic displays, and interfaces to computational programs), by closer involvement of measurers with CSEWG activities and by development of a prompt and systematic integral data testing program. The development of the ENDF/B-III reference data library is underway. ENDF/B-III will include some additional data files not available in ENDF/B-II and will also reflect experience gained in integral data testing of the ENDF/B-II data files. Present plans envision the maintenance and updating of the ENDF/B system relying heavily on the cooperative efforts of CSEWG and the coordination activities of NNCSC. (auth)

1132 (CONF-710301–(Vol.1), pp 360-6) RAYMATH, A PROBLEM-ORIENTED COMPUTER LANGUAGE DESIGNED FOR PROCESSING NEUTRON CROSS-SECTION DATA. Harlow, M. V.; Ferrell, K. D.; Plaisted, R.; Phillips, A. N. (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

RAYMATH consists of 52 modular instructions which permit operation upon and manipulation of six data arrays and 32 constants. Array mathematics, special purpose operations, and extensive graphical outputs may be readily achieved. All of the instructions as well as the language translator are written in FORTRAN IV for a CDC-6600 Computer. FORTRAN is a proper subset of RAYMATH. An application of RAYMATH to neutron capture gamma yield (barns) data from measurements made on ^{93}Nb over the resonance region of 35 eV to 10 keV is discussed. (auth)

1133 (CONF-710301–(Vol.1), pp 367-72) PHOTON PRODUCTION DATA REVIEW AND RETRIEVAL IN THE ENDF. Dudziak, Donald J. (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Recent developments in the checking of format syntax, internal consistency, and physical realism of photon production data are reviewed. Included are photon production cross sections, multiplicities, transition probability arrays, energy distributions, and angular distributions. Only data checks which can be automated are considered, and then only those which do not require an interactive capability with data storage systems other than ENDF. A code, VIXEN, has been written to perform such checking and to list processed data (e.g., total photon energy released in a reaction) convenient for a reviewer. Retrieval of photon production data is then discussed in the context of multigroup photon transport, with specific reference to the LAPHAN code. Suitable weighting functions are applied to the data over specified photon and neutron broad groups to construct the first L Legendre moments of the photon production matrix ($L \leq 4$). These moments are then used with the corresponding moments of the spatially dependent neutron flux to produce the Legendre moments of the spatially dependent multigroup photon source. (auth)

1134 (CONF-710301–(Vol.1), pp 373-8) CROSS-SECTION DATA ANALYSIS UTILIZING AN INTERACTIVE GRAPHICS DISPLAY. Lubert, M. (Knolls Atomic Power Lab., Schenectady, N. Y.); Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The interactive graphics program permits a rapid analysis of experimental capture and transmission data, eliminating the normal slow batch processing. The program MULTLVL is modular in design. The base overlay is a monitor program which executes a specified calculational path in which the final results are displayed on a CRT. The user can modify the path as well as the physical parameters (theoretical and experimental) for all the modules while in display mode. The final results may be automatically transferred to computer-generated plots, microfilm and/or printer plots. A typical analysis for one hundred resonances computes the resolution-broadened transmission for two thousand energy points in approximately 5 minutes on a CDC-6600. (auth)

1135 (CONF-710301–(Vol.1), pp 379-85) CROSS SECTION PROCESSING IN A MODULAR ENVIRONMENT. McGirt, Frank; Asprey, Margaret; Hoyt, Martha (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

There is currently an effort at Los Alamos to consolidate several cross section data libraries into one master library which will be able to provide input for any existing cross section processing code. The management of data from such a library using modular programming techniques is described. (auth)

1136 (CONF-710301–(Vol.1), pp 469-75) COMPARISON OF ENDF/B VERSION I DATA WITH THE CURRENT LASER LIBRARY. Page, E. M.; Mahna, K. L. (Atomic Power Development Associates, Inc., Detroit, Mich.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A critical comparison has been made between the standard LASER library and ENDF/B Version 1 data. Non-thermal parameters from both data sources were cast into a labeled multigroup format using LASER group definitions. Groupwise and total infinite dilute resonance integrals were computed as an aid in the data evaluation. ENDF/B pointwise cross sections for the

LASER thermal energy mesh were constructed from the smooth and resonance components given in ENDF/B format by interpolation and by application of the Breit-Wigner single level formulation. Comparison tabulations are given for the resulting 2200 m/sec values. Comparison plots were made with a Calcomp 565 plotter for the smooth data in both the thermal and non-thermal energy ranges. (auth)

1137 (CONF-710301–(Vol.1), pp 476-84) CONSISTENCY OF EVALUATED NEUTRON CROSS SECTIONS WITH CRITICAL-MASS DATA. Cain, G.; Rakavy, G.; Reiss, I.; Wagschal, J. J. (Hebrew Univ., Jerusalem (Israel)); Yeivin, Y. (Tel Aviv Univ. (Israel)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Critical-mass measurements of "clean" systems had been already used both to check and to modify microscopic cross-section libraries. The two ENDF/B versions released so far have been checked against several of the Los Alamos critical systems that had been recently re-evaluated. These studies have shown that the calculated critical masses still deviated significantly from their experimental values. In this note preliminary results are reported of an attempt to pinpoint the weaker links of ENDF/B-II, and actually determine the modifications necessary for a satisfactory reproduction of the experimental data. (auth)

1138 (CONF-710301–(Vol.2), pp 521-7) NEUTRON CROSS SECTION BEHAVIOR IN HIGH TEMPERATURE GASEOUS MEDIA. Oblow, Edward (Columbia Univ., New York).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A study was made of high temperature thermal cross sections in conjunction with research on gas fueled nuclear reactors. The Doppler effect at temperatures up to 100,000°K was investigated and a resonance peak shifting effect reported. Comparisons of rigorous and approximate methods of calculating temperature dependent cross sections were made. The effect of resonance scattering on the thermalization kernel was also examined, in light of the high thermal energies expected in gas fueled reactors. The behavior of the gas kernel in the vicinity of scattering resonances was evaluated and compared with constant potential scattering results. (auth)

1139 (CONF-710301–(Vol.2), pp 621-7) ACTIVITY OF THE IAEA-LABORATORY FOR UNIFYING NEUTRON FLUENCE MEASUREMENTS. Koehler, W. (International Atomic Energy Agency, Seibersdorf (Austria)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The neutron fluence is one of the predominant parameters to characterize reactor irradiations. There exists a definition, e.g., in ICRU-Report 13, but no commonly accepted routine measuring technique. Activation detectors are very often used in reactor exposure measurements in spite of some inherent disadvantages. According to recommendations of experts' groups, the IAEA-Laboratory started in 1967 a distribution program of inactive monitors and calibrated radioactive sources together with a description of how to make use of them. The fluence of slow neutrons can be determined from the activation of cobalt or cobalt-aluminum monitors. The method is based on discussions by the EURATOM-Working Group on Reactor Dosimetry. The fluence of fast neutrons can be determined from the activation of nickel or iron monitors. In addition to the ^{58}Co and ^{54}Mn standard sources, ^{59}Fe sources are offered. For calculating the fluence of neutrons with energies greater than 0.1 MeV, an apparent cross section is introduced which is based on the calculated neutron energy distribution of the irradiation facility. This service of the IAEA-Laboratory should not only provide small laboratories with material not available to them in the desired quality and quantity, but it should be a guide for more precise determinations and uniform presentation of fluence values in the various reactor centers. (auth)

1140 (CONF-710301–(Vol.2), pp 695-700) COLD NEUTRON CROSS SECTIONS OF POLYPHENYLS. Sefidvash, F. (Arya-Mehr Univ. of Technology, Tehran (Iran)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The total neutron cross sections of hydrogen bound in benzene, diphenyl, Dowtherm-A, meta-, ortho-, and paraterphenyl have been measured by the time-of-flight method in the energy range of 0.2 – 3.0 MeV. The results are compared with the author's scattering model for polyphenyls. (auth)

1141 (IAE–1973) PROGRAMMES FOR CALCULATING RELAXATION LENGTHS AND RETHERMALIZATION LENGTHS FOR A NEUTRON FLUX ON THE BASIS OF EXPERIMENTAL DATA. Trukhanov, G. Ya. (Institut Atomnoi Energii, Moscow (USSR)). 1970. 72p. (In Russian). INIS.

Methods are briefly explained for recovery of the fundamental and first relaxation lengths and the rethermalization lengths for a neutron flux from experimental data. An Algol-60 program is offered which provides the following: the relaxation and rethermalization lengths from an experimental three-dimensional temperature distribution of a neutron gas ("Tempel'-3" and "Tempel'-2"), and the rethermalization length on the basis of the differential scattering cross section ("Emodis") and the neutron spectra ("STER-A"). (INIS)

1142 (LA–4757) SIMPLIFICATION OF RAY EFFECT CORRECTIONS IN TRANSPORT CALCULATIONS. Carlson, Bengt G. (Los Alamos Scientific Lab., N. Mex.). Sep 1971. Contract W-7405-eng-36. 12p. Dep. NTIS.

A proposed scheme for eliminating flux distortions (ray effects) in two-dimensional and three-dimensional discrete S_n transport calculations is rederived on the basis of somewhat simpler, more general arguments. It is then shown that the associated source term corrections can be put in a form which is easier to compute and less dependent on geometry than forms given in earlier reports. In practice, these improvements should translate into significant savings of computer time. (auth)

1143 (UJV–2481–R) MEASUREMENT OF DIFFUSION PARAMETERS OF THERMAL NEUTRONS IN WATER AND WATER SOLUTIONS WITH BORON ABSORPTION. Kryl, F. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 19p. (In Czech). INIS.

Relaxation lengths of thermal neutrons were measured in water and water solutions of boric acid with an inaccuracy of less than 1%. The measurements were taken in a cylindrical vessel situated in the thermal column of the VVR-S reactor. The temperature of water and the solutions was 22 to 23°C and was measured with an accuracy of 0.25°C. The neutron distribution was corrected for higher harmonics of the neutron flux. The relaxation lengths found served to determine the diffusion lengths in water and in the solutions, and the coefficients of diffusion and diffusion heating of water. Theoretical values of relaxation lengths were obtained by solving the multispeed transport equation in a P3 approximation with Nelkin and Koppel–Young models of neutron scattering. The corrected results were in close agreement with other authors' measurements. The measurement of diffusion coefficient and diffusion heating coefficient yielded less accurate values owing to a smaller number of boric acid concentrations used and to inaccuracies in the determination of concentration. (INIS)

1144 DEVICE FOR PRODUCING NEUTRON BURSTS. Lecorche, Pierre (to Commissariat a l'Energie Atomique). French Patent 2,052,189. 29 Mar 1971. Filed 25 Jul 1969. (In French).

A method for producing controlled neutron bursts is described. The method involves the vertical displacement of the free surface of a fissile solution, contained in a vessel, relative to a neutron reflector, such that the solution is brought from a sub-critical state to a slightly super-critical state at ambient temperature. The temperature of the solution is allowed to increase under the action of the heat released from the fission until the chain reaction is partially extinguished; the separation between the free surface and the reflector is then returned to its initial value. (France)

1145 MEASUREMENTS OF NEUTRON THERMALIZATION PARAMETERS OF LIGHT WATER WITH NON-1/v ABSORBER USING PULSED NEUTRON TECHNIQUE. Fujimo, Michihira (Osaka Univ.); Hoshino, Tsutomu; Sumita, Kenji. J. Nucl. Sci. Technol. (Tokyo); 8: No. 8, 423-30(Aug 1971).

Asymptotic neutron decay constants were measured in effectively infinite light-water systems poisoned with Cd and Gd as non-1/v absorbers by changing the concentration of the absorbers added. The capture γ-ray counting technique was used for detecting the decaying neutron to eliminate the spatial higher modes. The effective absorption cross section α and the absorption cooling (or heating) coefficient β derived from the measured decay constant curves vs concentration were $3,343 \pm 42$ b and $(0.61 \pm 0.03) \times 10^{-17}$ b cm^3 for Cd and $4,0211 \pm 230$ b and $(9.6 \pm 1.1) \times 10^{-17}$ b cm^3 for Gd, respectively. For α, the calculations reported so far, based on the Nelkin model, are in good agreement with the measurements, while a significant discrepancy appears in the comparison of β. (auth)

1146 NEUTRON TRANSMISSION PROPERTIES OF Cd AND B FILTERS IN MODERATING MEDIA AND ITS APPLICATION IN THE DETERMINATION OF 1/E-SPECTRUM. Sekiguchi, Akira; Wakabayashi, Hiroaki; Nakazawa, Masaharu; Koizumi, Yoshinobu

(Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 8: No. 8, 413-22 (Aug 1971).

The energy-dependent neutron transmission function of the Cd filter covering a cylindrical 1/v detector is calculated, with consideration given to the perturbation effect in the surrounding medium. The results are found to agree well with experiments using a lead slowing-down time spectrometer. The effective Cd cutoff energy for 1 mm thick Cd is calculated from the above transmission function, and found to be about 50% larger than the reported values. The validity of the assumption of a $1/E^{1+\beta}$ spectrum in a graphite moderator is discussed; and the β value, determined with an accuracy of 0.01 from the reaction rate ratio of BF_3 counters covered with the different thicknesses of Cd and B filters. The region of the 1/E-spectrum neutron field in the graphite standard pile is determined by using this technique. (auth)

1147 APPLICATION OF NORMAL MODE EXPANSION METHOD FOR THE THERMAL-NEUTRON MILNE PROBLEM. Yamagishi, Tomejiro (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 8: No. 8, 470-3(Aug 1971).

The normal-mode expansion method is extended to the case of discontinuous cross section. The concrete form of solutions in the infinite half-space is calculated numerically, and the effect of the Bragg cutoff on the neutron density near the free surface is examined. As an example, the solution for the Milne problem with actual physical variables is derived. (R.W.R.)

1148 EFFECT OF LATERAL LEAKAGE ON NEUTRON WAVES. Klinc, T.; Kuscer, I. (Cornell Univ., Ithaca, N. Y.). Transp. Theory Statist. Phys.: 1: No. 1, 41-58(Jan 1971).

A mathematical description is given for a neutron wave propagating parallel to the surface of a semi-infinite medium or of a slab. Cercignani's method of singular eigenfunction expansions [Ann. Phys., 40: 454(1966)] is applied under the assumption of one-speed isotropic scattering. Half-range orthogonality and closure relations for the eigenfunctions are derived, with the necessary precautions taken to account for the zeros of the dispersion function inside the area spectrum. The analog of the Milne problem is solved; and the complex extrapolated endpoint, evaluated. Several coefficients in an expansion of the latter quantity in terms of two characteristic parameters are computed. The results are used to derive an asymptotic solution of the slab problem, where a complex transverse buckling appears. For typical experiments on large assemblies $\mathrm{Im}(B^2)$ is sufficiently small to be neglected. (auth)

1149 VALIDITY OF CONSTANT COLLISION DENSITY ASSUMPTION IN INTERMEDIATE-ENERGY REGION. Nakamura, Kunihiko; Nishihara, Hiroshi (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 8: No. 8, 465-8(Aug 1971).

The accuracy of the assumption of constant collision density in the intermediate-energy region is examined numerically. For calculation of the exact neutron spectrum and the effective cross section for overlapping resonances a modified version of the ZUT code was used in which the shape of the overlapping resonances is given by superposition of the single-level formula for individual resonances. The transient in collision density for an isolated resonance of ^{238}U in a homogeneous mixture of ^{238}U and ^{12}C is calculated, as well as for overlapping resonances in homogeneous mixture and in heterogeneous geometry. The effect of the constant collision density assumption in terms of the effective cross section of the overlapping resonance region is tabulated. It is found that the assumption of constant collision density in the homogeneous case is acceptable in the intermediate-energy region; the constant collision density assumption in the heterogeneous case yields noticeable errors in the intermediate-energy region; and the use of the equivalence relation becomes questionable below 1 keV for $\sigma_m = 480$ b and below 100 eV for $\sigma_m = 4800$ b, where σ_m is the background scattering cross section per resonant nucleus. (R.W.R.)

1150 PULSED-NEUTRON DIFFUSION PARAMETERS IN MIXTURES OF HEAVY AND LIGHT WATER AND ICE. Salaita, George N. (Southern Methodist Univ., Dallas); Robeson, Andrew. Nucl. Sci. Eng.: 46: No. 2, 214-22(Nov 1971).

The diffusion parameters for mixtures of 0, 20, 50, 80, and 100% D_2O in H_2O have been measured by the pulsed-neutron method at temperatures near the freezing point and in ice at −20°C. A 250-keV Cockcroft–Walton accelerator was used to produce neutron bursts in cylindrical samples by the $^2H(d,n)^3He$ reaction. The waiting time method was used for establishment of the asymptotic spectrum in each sample. The infinite medium decay constants for D_2O were evaluated from known density and nuclear cross-section data; those for H_2O, H_2O ice, and (H_2O + D_2O) mixtures were determined by a three parameter least-squares fit of the experimental data to the equation $\lambda = \lambda_0 + D_0B^2 - CB^4$. An iterative procedure was used to make the value of the extrapolated distance compatible with the diffusion coefficient D_0 derived from the least-squares analysis. The results are compared with those of similar measurements by other workers for H_2O and D_2O at various temperatures. The effect of the liquid–solid phase transition on the diffusion coefficient and diffusion cooling coefficient in H_2O and D_2O is discussed. The expression $D_0 = 1/\Sigma_i\, \alpha_i/D_{0,i}$, where α_i and $D_{0,i}$ are the fractional volume and diffusion coefficient of the i'th component of the mixture, respectively, gave lower values than the experimental results for the mixtures. (auth)

1151 TEMPERATURE DEPENDENCE OF NEUTRON INELASTIC SCATTERING FROM WATER. Esch, L. J. (Rensselaer Polytechnic Inst., Troy, N. Y.); Yeater, M. L.; Moore, W. E.; Seemann, K. W. Nucl. Sci. Eng.: 46: No. 2, 223-35(Nov 1971).

The double differential neutron scattering cross section for water has been measured at temperatures of 27, 170, and 270°C. The RPI linear electron accelerator provided the pulsed neutron source for a time-of-flight analysis of neutron energy. By phasing the LINAC with a high speed chopper, incident neutron energies ranging from 0.04 to 0.632 eV were selected. Energy distributions of scattered neutrons were obtained at scattering angles of 10, 14, 25, 40, 60, 90, 120, and 150°. The relatively wide range of incident energies with good resolution made it possible to observe clearly the molecular energy levels. The structure was seen to broaden considerably in going from 27 to 170°C but was little changed by the further temperature increase. A model has been developed in which the water scattering system is considered as consisting of aggregates of molecules. These clusters have temperature-dependent sizes, and diffuse according to a temperature-dependent diffusion constant. The energy levels of the molecules bound in the cluster are represented by a multi-Gaussian frequency distribution which varies with temperature. The internal vibrations of the individual water molecules are represented by delta functions. A new approach has been taken in comparing this and other models with the data, involving the application of recent improvements in methods of treating resolution and multiple scattering: a Monte Carlo technique has been used to impose these conditions on the models. These comparisons, and comparisons with integral data, indicate that the new model should have advantages for reactor calculations. (auth)

1152 EFFECT OF TRANSVERSE DIMENSIONS ON THE DIFFUSION LENGTH OF NEUTRONS IN CRYSTALLINE MODERATOR ASSEMBLIES. Ahmed, Feroz (Univ. of Delhi); Kothari, L. S.; Kumar, Ashok. Nucl. Sci. Eng.; 46: No. 2, 203-13(Nov 1971).

The dependence of neutron diffusion length on the size and shape of the cross-sectional area of infinitely long rectangular blocks of crystalline moderators (graphite and beryllium) has been studied using an energy-dependent transverse buckling. In conformity with the experimental results in graphite, the diffusion length is found to increase with a decrease in the transverse size of the assembly. It is further found that in assemblies with small transverse dimensions, pseudo-equilibrium conditions are established fairly rapidly and reasons for this are discussed. On the other hand, in assemblies with intermediate transverse dimensions (cross-sectional area lying between 70×70 cm^2 and 50×50 cm^2 for graphite and between 30×30 cm^2 and 20×20 cm^2 for beryllium), even pseudo-equilibrium conditions are not established at very large distances from the source. Dependence of the diffusion length on the shape of the cross-sectional area is also investigated. (auth)

1153 DEVELOPMENT OF A PULSED NEUTRON GENERATOR TO STUDY REACTORS. Kir'yanov, G. I.; Allakhverdov, A. Sh.; Gusev, A. V.; Kolganova, I. V. (All-Union Scientific Research Inst. of Radiation Tech., Moscow). Tr. Vses. Nauch.-Issled. Inst. Radiats. Tekh.; No. 5, 265-74(1970). (In Russian).

A neutron generator was developed with a mean neutron flux of 10^7 neutron/sec with a pulse repetition rate of up to 20 Hz and a pulse width of ~1.5 μsec. The length of the neutron source is 1100 mm and the diameter is 48 mm. Measurement of the operating stability of the generator showed that in 2 hours of operation the maximum deviation of the output of neutrons from the mean value did not exceed 8%. (JPRS)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 995, 1176, 1199, and 1375.

1154 (CONF-710301-(Vol.2), pp 528-42) PRESENT STATUS OF STANDARDS. Landon, H. H. (National Bureau of Standards, Washington, D. C.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The status of neutron cross section data for nuclei generally accepted as standards or potentially useful as such is presented. This includes our knowledge of the cross sections of the light elements from hydrogen through carbon. The accuracy with which these data are known over the energy range of interest in nuclear technology is presented. The status of the data for cross sections useful as secondary or relative standards for reactions such as capture and fission is presented. Areas of interest for future work to improve our knowledge of the cross-sections which comprise the basis of our measurement system for neutron cross sections and neutron flux are summarized. (auth)

1155 (CONF-710301-(Vol.2), pp 816-22) LINE AND CONTINUUM GAMMA-RAY YIELDS FROM THERMAL NEUTRON CAPTURE IN 75 ELEMENTS. Orphan, V. J. (Gulf Radiation Technology, San Diego, Calif.); Rasmussen, N. C.; Harper, T. L. (Massachusetts Inst. of Tech., Cambridge).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Thermal neutron capture γ-ray spectra for 75 natural elements obtained at the MIT thermal capture γ-ray facility using a Ge(Li)-NaI pair spectrometer have been analyzed to obtain the yield of continuum γ-rays for energies >1.5 MeV. The yields of discrete lines have been previously reported. For 27 elements, 70% or more of the expected γ-ray energy was observed in the resolved lines and the continuum contribution could be assumed negligible. For the others, the continuum varied from 19% of the binding energy for cobalt to 98% of the binding energy for europium. The percent of the total binding energy observed was within 100 ± 20% for over two-thirds of the elements. The sum of the line and continuum yields, grouped into 250-keV bins and normalized to the known average binding energy for each element, have been placed on magnetic tape in the ENDF format. (auth)

1156 (KFK-1382) DIFFERENTIAL CROSS SECTION FOR THE ELASTIC ^{3}He + ^{4}He SCATTERING AT ENERGIES FROM 28 TO 44 MeV IN THE CENTER-OF-MASS SYSTEM. Fetscher, W.; Seibt, E.; Weddigen, Ch.; Kanellopoulos, E. J. (Kernforschungszentrum, Karlsruhe (West Germany)). Mar 1971. 10p. (In German). (CONF-710333-1). Dep. NTIS (U. S. Sales Only).

From Meeting on nuclear physics; Wuerzburg, Germany (2 Mar 1971).

The elastic scattering of 103 MeV ^{4}He particles on ^{3}He is possibly an interesting candidate for the production of a high-energy polarized ^{3}He beam. The methods which were used to describe the scattering mechanism at center-of-mass energies E_{CM} below 24 MeV are discussed. Angular distributions for E_{CM} from 28 to 44 MeV have been measured at the Karlsruhe cyclotron in order to get information about the reaction mechanism involved. The experimental results clearly favor the cluster model interpretation of the scattering process. Especially the enhancement of the differential cross section in the backward direction is definitely attributed to neutron exchange as a direct consequence of the Pauli principle and not to spin-orbit effects. Nucleon-nucleon spin-orbit effects are expected to be small in this angular region for E_{CM} above 30 MeV. (auth)

1157 (RPI-328-226) LINEAR ACCELERATOR PROJECT. Progress Report, April 1, 1971-June 30, 1971. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-1)-328. 71p. Dep. NTIS.

ALUMINUM—neutron spectra in, fast, (E)
DEUTERIUM—neutron total cross section at 1 to 30 MeV, (E)
GAMMA SPECTROMETERS—count-rate and gain-shift tests of
HYDROGEN—neutron total cross section at 1 to 20 MeV, (E)
IRON—neutron total cross section near 24.6 keV, (E)
—neutron elastic scattering at 18 to 406 keV, differential cross sections for, (E)
NEUTRON BEAMS—resonance filters for, for time-of-flight experiments
RADIATION DETECTORS, SEMICONDUCTOR (GERMANIUM)—efficiency of lithium-drifted, for γ rays of 0.84 to 8.9 MeV
SODIUM—neutron spectra in metallic, fast, (E) (J.W.R.)

1158 CORRECTION FOR CENTER-OF-MASS MOTION IN VARIATIONAL CALCULATION OF NUCLEAR RADII AND ENERGIES. Gadioli-Erba, E.; Sona, P. G. (CISE, Milan. Univ., Milan). Energ. Nucl. (Milan); 18: No. 9, 482-6 (Sep 1971).

A better definition of rms nuclear radius is suggested for variational calculation of nuclear properties based on independent-particle wave functions. It is shown, by repeating the classical calculations of Brink and Boeker [Nucl. Phys., A91, 1(1967)] for spherical nuclei, that a much better agreement with experimental data is thus obtained. (auth)

1159 ELECTRON DISINTEGRATION OF HELIUM BETWEEN 45 AND 100 MeV. Murphy II, James Jefferson. Urbana, Ill.; Univ. of Illinois (1971). 192p. University Microfilms Order No. 71-21,190.

Thesis.

The differential cross section for ^{4}He(e,e'n)^{3}He was measured at five angles over an energy range of 45 to 100 MeV. The charged reaction products were detected by 10 lithium-drifted silicon detectors cooled to 77°K located in the focal plane of the double-focusing 120° wedge magnet of the positive-ion spectrometer. The data were analyzed using virtual photon spectra to yield photodisintegration cross sections corresponding to the reaction ^{4}He(γ,n)^{3}He. The resulting differential cross sections are consistent with the form $(d\sigma/d\Omega) = A \sin^2\theta(1 + \beta \cos\theta)$. The total cross section decreases exponentially from a value of 360 μb at 45 MeV to 60 μb at 100 MeV. The asymmetry coefficient, β, increases monotonically from −0.2 at 45 MeV to +1.0 at 100 MeV. At the highest energies measured the asymmetry coefficient of the ^{4}He(γ,n)^{3}He reaction is equal that of the ^{4}He (γ,p)^{3}H reaction as measured by Gorbunov. A calculation of the cross section is made in the long-wave-length limit; meson effects are neglected, and Gaussian wave functions are used. Both E1 and E2 contributions to the cross section are considered. This calculation leads to the largely exponential energy dependence for the cross section and the dominant $\sin^2\theta$ term in the angular distribution. But for reasonable choices of the Gaussian wave function parameters this calculation does not accurately describe the energy dependence of the cross section or the observed behavior of the asymmetry coefficient. The experimental data are also compared to published theoretical calculations. (TSS)

1160 PHOTODISINTEGRATION OF HELIUM INTO PROTONS AND TRITONS BETWEEN 180 AND 320 MeV. Kiergan, Stephen Edwards. Urbana, Ill.; Univ. of Illinois (1971). 120p. University Microfilms Order No. 71-21,152.

Thesis.

The differential cross section for the reaction ^{4}He(γ,p)t was measured for cm angles between 60 and 120 degrees and photon energies between 180 and 320 MeV. Photons from a 320-MeV bremsstrahlung beam produced by the University of Illinois 340-MeV betatron struck a liquid ^{4}He target. The angle of the triton and the range and angle of the proton were determined by an array of scintillation counters and spark chambers grouped around the target. Events were selected to be ^{4}He(γ,p)t events on the basis of the coplanarity of the reaction products and the closeness of the mass calculated for the particle presumed to be a triton to the actual triton mass. The results showed a continuation of the exponential decrease of the differential cross section with photon energy after a leveling off in the region from 180 to 230 MeV. The angular distributions displayed a forward peaking of the cm proton distribution, with the peaking increasing with increasing photon energy. For energies below 260 MeV, a distribution of the form $(d\sigma/d\Omega^*) = A \sin^2(\theta^*)[1 + \beta \cos(\theta^*) + \gamma \cos^2(\theta^*)]$ gave a reasonable fit to the data. The 90°cm differential cross sections measured were in disagreement with those of Picozza, who found a pronounced peak in the cross section centered at approximately 280 MeV. (Diss. Abstr. Int., B)

1161 DIFFERENTIAL CROSS SECTIONS FOR THE ^{2}H(γ,p)n REACTION BETWEEN 25 AND 55 MeV. Weissman, B.; Schultz, H. L. (Yale Univ., New Haven). Nucl. Phys.; A174: No. 1, 129-47(1971).

Differential cross sections for the ^{2}H(γ,p)n reaction were measured at seven laboratory angles from 30° to 150° for photon energies between 25 and 43 MeV, with additional results up to 55 MeV at the larger angles. The measured angular distributions were fitted with sums of Legendre polynomials, and the results compared with the calculation of Partovi. Significant departures from the calculated total cross section and angular distribution asymmetry have been found. (auth)

1162 APPARENT VIOLATION OF ISOSPIN SYMMETRY IN THE REACTION ^{2}H(α,t)^{3}He NEAR THRESHOLD. Wagner, G. J.; Foster, C. C.; Greenebaum, B. (Princeton Univ., N. J.). Nucl. Phys.; A174: No. 1, 123-8(1971).

The differential cross section of the ^{2}H(α,t)^{3}He reaction has been measured between $\theta_{c.m.}$ = 17° and 152° at an incident α-energy of 48.25 MeV. This represents a test of the Barshay-Temmer theorem, which requires symmetry of the angular distributions about 90°. Earlier experiments have found no asymmetry at lower incident α-energies and deviations of up to 10% at higher incident

energies. Deviations from symmetry as large as 20% at some angles were found. (auth)

1163 PHASE-SHIFT ANALYSIS OF POLARIZATION AND DIFFERENTIAL CROSS SECTION IN p–^{4}He ELASTIC SCATTERING BETWEEN 25 AND 29 MeV. Ramavataram, K. (Rutherford High Energy Lab., Chilton, Eng.); Plummer, D. J.; Hodges, T. A.; Montague, D. G. Nucl. Phys.; A174: No. 1, 204-20(1971).

Phase-shift analyses have been carried out on the polarization and cross-section data in p + ^{4}He elastic scattering between 25 and 29 MeV. The results show that the spin and parity of the 20 MeV resonance in ^{5}Li are $\frac{1}{2}^+$. From the phase-shift set obtained for this partial wave, the parameters of this resonance are estimated. The results also indicate a resonance with $J^\pi = \frac{1}{2}^+$ at about 18 MeV excitation in the ^{5}Li system. (auth)

1164 MEASUREMENT OF POLARIZATION AND DIFFERENTIAL CROSS SECTION IN p–^{4}He ELASTIC SCATTERING BETWEEN 25 AND 29 MeV. Plummer, D. J. (Queen Mary Coll., London); Ramavataram, K.; Hodges, T. A.; (and others). Nucl. Phys.; A174: No. 1, 193-203(1971).

p–^{4}He polarization and elastic differential cross-section angular distributions have been measured at 25.0, 26.1, 27.1, 28.2 and 29.2 MeV incident proton energy. The angular distributions were measured in 5° intervals from 20° to 160° (lab) for the polarization and from 30° to 160° (lab) for the differential cross section. The polarization measurements were generally such that $\Delta P \leq \pm 0.03$ whilst the differential cross-section errors were ≲3% except at forward angles. The normalization accuracies were determined to be ±1% for the polarization and ±3.5% for the differential cross section. (auth)

1165 ANGULAR AND ENERGY CORRELATION OF NEUTRONS IN REACTION d(n,2n)p AT E_0 = 14 MeV. Saukov, A. L; Chernukhin, Yu. I.; Oparin, E. M.; Gornitsyn, G. A. Yadern. Fiz.; 14: No. 2, 277-86(Aug 1971). (In Russian).

The neutron spectrum from the reaction D(n,2n)p at E_0 = 14.3 MeV was measured by means of a double time-of-flight method with account of the neutron angular and energy correlation ($d^3\sigma/d\Omega_1 d\Omega_2 dE_1$) under the angles of θ = 20° (the polar angle) and φ = 45 and 135° (the azimuthal angle) to the incident beam direction. The experimental results are in good agreement with the theoretical cross section of the reaction calculated in the pole approximation. On basis of the obtained experimental data and calculations the neutron–neutron scattering length is determined to be $a_{nn} = 25 \pm 3$f. (auth)

1166 TENSOR-FORCE EFFECTS AND A NEW N–N SEPARABLE POTENTIAL IN THE 3-N SYSTEM. Avalos, D. R. (Univ. Nacional, La Plata. International Centre for Theoretical Physics, Trieste, Italy); Epele, L. N.; Gregorio, M. A. Lett. Nuovo Cim.; 2: No. 9, 441-2(28 Aug 1971).

The triton binding energy and the nucleon–deuteron doublet scattering length were calculated using the Tabakin interaction for the $^1S_0$ state while including a more realistic potential for the $^3S_1$ state and including a tensor force. A numerical solution of the Faddeev–Lovelace equations gave a fair agreement with experiment for the triton binding energy but a gross disagreement for the doublet scattering length. (J.W.R.)

1167 PHOTOPRODUCTION OF CHARGED π MESONS ON NUCLEI. Goncharov, N. V.; Derebchinskii, A. I.; Konovalov, O. P.; Tonapetyan, S. G.; Khvorostyan, V. M. (Physical–Technical Inst., Kazan). Yadern. Fiz.; 14: No. 1, 31-4(Jul 1971). (In Russian).

The relative yield of π^+ mesons and the ratio of the yields for the π^+ and π^- mesons emitted with energy 40 ± 10 MeV at the angles θ_{lab} = 50–160° in the reactions induced by photons with energies up to E_γ^{max} = 500 MeV on light and intermediate nuclei were measured. A 34-cm freon bubble chamber with a beam tube was used to detect the charged π mesons. The π^-/π^+ yield ratios for ^{4}He, ^{7}Li, ^{12}C, ^{28}Si, ^{32}S, ^{40}Ca, ^{93}Nb are found to be 0.94 ± 0.14, 2.15 ± 0.31, 1.22 ± 0.21, 1.25 ± 0.15, 1.0 ± 0.13, 1.11 ± 0.13; 1.53 ± 0.25, respectively. The π^+-meson yield is established to be governed by the $ZA^{-\frac{1}{3}}$ law. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 38, 1154, 1155, 1158, 1167, 1200, 1215, 1302, 1375, 1380, 1384, 1396, and 1401.

1168 (CONF-710301–(Vol.1), pp 325-31) TOTAL CROSS SECTION MEASUREMENTS WITH A ^{252}Cf TIME-OF-FLIGHT SPECTROMETER (LWBR DEVELOPMENT PROGRAM). Green, L. (Bettis Atomic Power Lab., West Mifflin, Pa.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A time-of-flight spectrometer employing a 1 μgram sample of ^{252}Cf as a neutron source is being used to obtain total cross section data in the energy range 0.5–10 MeV. Measurements have been completed for carbon and zirconium and the results are presented. (auth)

1169 (CONF-710301–(Vol.2), pp 551-9) REVIEW OF THE DATA ON THE ^{6}Li CROSS-SECTIONS BELOW 1.7 MeV. Uttley, C. A.; Sowerby, M. G.; Patrick, B. H.; Rae, E. R. (Atomic Energy Research Establishment, Harwell (England)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The data on the total, (n,α), (n,n) and (n,γ) cross sections of ^{6}Li have been reviewed below a neutron energy of 1.7 MeV. The data on the differential (n,α) and (n,n) reactions have been considered but particular emphasis has been placed on obtaining the variation of the (n,α) cross-section with neutron energy. The best values of this cross section are indicated and it is estimated that the values are known (one standard deviation) to ±0.5% at thermal energies, ±1% from thermal to 10 keV, ±2% at 100 keV, ±5% from 150 to 300 keV, ±10% at 500 keV, and ±15% from 700 to 1700 keV. (auth)

1170 (CONF-710301–(Vol.2), pp 611-20) ^{6}Li(n,α)^{3}H CROSS SECTION AND RESONANCE PARAMETERS FOR THE P-WAVE RESONANCE NEAR 260 keV. McPherson, M. R.; Gabbard, F. (Kentucky Univ., Lexington. Dept. of Physics and Astronomy).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Experimental results for the ^{6}Li(n,α)^{3}H cross section are presented for neutron energies on the interval between 50 keV and 600 keV. These results and many other data on neutron scattering and reactions with ^{6}Li are analyzed to determine the resonance parameters for the resonance in ^{6}Li + n near a neutron energy of 260 keV. (auth)

1171 (FRNC-TH-46) UTILIZATION OF AN ON-LINE COMPUTER FOR THE CONTROL AND HANDLING OF MULTIPARAMETER NUCLEAR PHYSICS EXPERIMENTS. Maillard, J. P. (Grenoble Univ. (France)). 1971. 55p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Experimental equipment was developed for the control and handling of multiparameter experiments. The system was automated to the maximum in order to avoid time wastage and to concentrate the maximum amount of time on the experiment. This equipment was used to study the ^{6}Li(α,2α)d reaction. The experiments carried out using the network of the Grenoble nuclear center in the study of the ^{11}B(p,3α) reaction are presented. (France)

1172 (JINR–P-1-5892) ^{8}B PRODUCTION IN THE CAPTURE OF STOPPED π-MESONS BY NITROGEN NUCLEI. Agababian, N. M.; Batusov, Yu. A.; Bunyatov, S. A.; Gulkanian, H. R.; Sidorov, V. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR) Lab. of Nuclear Problems). 1971. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

The events of ^{8}B fragment production in pion capture by light nuclei in photoemulsion were separated from 1500 two prong T-track events by means of the kinematic analysis. It is shown that ^{8}B is produced, in general, in absorbing π-mesons by nitrogen nuclei. The relative probability of the production in the reactions with nitrogen is equal to (1 to 1.3) · 10^{-3}. The upper limits for the production probability of the bound multinucleon states (n^3, n^4 and n^5) are given as well as for neutron rich isotope ^{6}H in the reactions with the ^{8}B production by nitrogen. (auth)

1173 (LYCEN-7142) MECHANISM OF (α,2α) REACTIONS ON ^{12}C AND ^{16}O AT INTERMEDIATE ENERGIES. Mithra, B.; Laverriere, R. (Lyon Univ. (France). Institut de Physique Nucleaire). Jun 1971. 12p. Dep. NTIS (U. S. Sales Only).

The (α,2α) reactions with ^{12}C and ^{16}O were studied in the framework of the dispersion theory, using a triangular Feynman graph. The dependence of the α angular distribution on the quasi-free α-α scattering at various energies was discussed. (France)

1174 (ORNL–4649) ELECTRONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1970. Howard, F. T. (ed.) (Oak Ridge National Lab., Tenn.). May 1971. Contract W-7405-eng-26. 127p. Dep. NTIS.

ALUMINUM-27—helium-3 elastic scattering at 59.8 MeV, optical-model analysis of, (E/T)

BORON-12—energy level from carbon-14 (p,He-3) reactions, lowest T = 2

CADMIUM-116—oxygen-16 reactions at 140 MeV, charged-particle spectra from, (E/T)
CALCIUM-40—neon-20 reactions (Ne-20, O-16) at 63 and 73.7 MeV, differential cross sections for, (E)
CARBON-12—helium-3 reactions (He-3,n) at 25.4 MeV, angular distributions for, (E)
CARBON-13—nitrogen-14 reactions (N-14, N-13) at 12 to 22 MeV, DWBA analysis of, (E/T)
CARBON-14—proton reactions (p, He-3) at 63.4 MeV, helium-3 spectra and angular distributions for, (E)
CHLORINE-34—energy levels of, shell-model calculations for, (E)
COBALT-59—alpha elastic scattering at 50 MeV, angular distributions for, (E)
ELECTRON MICROSCOPES—development of high-resolution, at ORNL
GADOLINIUM-158—energy-level scheme from europium-158 decay, (E)
HELIUM-3—deuteron reactions (d,t) at 39.1 MeV, analysis of final-state interaction in, (E)
HYDROGEN—deuteron reactions (d, He-3) at 20 to 45.2 MeV, angular distributions and excitation functions for, (E)
IRON—helium-3 reactions up to 70 MeV, excitation functions for production of cobalt and nickel isotopes in, (E)
NEODYMIUM-142—proton reactions (p,d) and (p,t) with, deuteron and triton spectra from, (E)
NEODYMIUM-144—proton reactions (p,d) and (p,t) with, deuteron and triton spectra from, (E)
NEODYMIUM-146—proton reactions (p,d) and (p,t) with, deuteron and triton spectra from, (E)
NEODYMIUM-148—proton reactions (p,d) and (p,t) with, deuteron and triton spectra from, (E)
NEODYMIUM-150—proton reactions (p,d) and (p,t) with, deuteron and triton spectra from, (E)
NEUTRONS—interactions n + p at 60 MeV, differential cross section for, (E)
NICKEL-60—helium-3 elastic scattering at 50 and 71 MeV, optical-model analysis of, (E/T)
—alpha elastic scattering at 50 MeV, angular distributions for, (E)
NOBELIUM-255—alpha decay of, α-x-ray coincidence spectra from, (E)
NOBELIUM-259—alpha decay of, search for, (E)
NUCLEI—proton total cross sections at 30 to 60.8 MeV for A-12 to 208, optical-model fits to, (E/T)
ORNL ISOCHRONOUS CYCLOTRON—operation in 1970
—experimental facilities at, development of
OXYGEN-18—helium-3 reactions (He-3, t) at 25 and 50 MeV, angular distributions for, (E)
PROTONS—interactions n + p at 60 MeV, differential cross section for, (E)
SILICON-28—helium-3 reactions (He-3, n) at 26.2 MeV, angular distributions for, (E)
SULFUR-34—energy levels of, shell-model calculations for, (E)
TERBIUM-155—energy-level transitions from dysprosium-155 decay, internal conversion coefficients and multipolarities for, (E)
YTTRIUM-89—helium-3 reactions (He-3, t) at 25 MeV, test of radial wave functions by, (E/T)
—proton reactions (p, n) at 30 MeV, test of radial wave functions by, (E/T) (J.W.R.)

1175 ELASTIC SCATTERING AND REACTIONS IN THE BOMBARDMENT OF ^{14}N BY 20 MeV DEUTERONS. Pickles, William Lucas. East Lansing, Mich.; Michigan State Univ. (1970). 373p. University Microfilms Order No. 71-18,273.

Thesis.

Differential cross sections from 10 to 170 degrees and integrated cross sections are reported for the following reactions at 20.13 MeV: $^{14}N(d,d)^{14}N$, $^{14}N(d,d')^{14}N^*$, $^{14}N(d,t)^{13}N$, $^{14}N(d,^3He)^{13}C$, and $^{14}N(d,\alpha)^{12}C$. Integrated reaction cross sections are reported for the following: $^{14}N(d,pN)$, $^{14}N(d,p)$, and $^{14}N(d,\alpha X)Y$. The total reaction cross section for deuterons on ^{14}N is computed considering all of the above. Also reported are differential cross sections from 15 to 50 degrees and integrated cross sections for the following: $^{16}O(d,d)$, $^{16}O(d,d')^{16}O^*$, and $^{16}O(d,\alpha)^{14}N$. The elastic cross section $^{14}N(d,d)$ has absolute errors of less than two percent. Optical potentials were fit to these data, and many essentially equivalent potentials were found. The potential with the lowest chi-square per point (34.5) has a volume imaginary term (W_v) of 3.62 MeV and a surface imaginary term (W_D) of 2.36 MeV, with the imaginary radius parameter 1.63 F. The isotopic spin for many levels of ^{14}N up to 14 MeV was assigned as zero on the basis of the $^{14}N(d,d')^{14}N^*$ measurements. The angular distributions and integrated cross sections in the $^{14}N(d,d')^{14}N^*$ reaction are discussed in terms of weak coupling between two 1^+ nucleons and the 2^+ and the 3^- configuration of ^{12}C and between two 1^+ holes and the 3^- configuration of ^{16}O. A complete prescription for the fabrication of 3-mm silicon surface barrier detectors is also presented. (TSS)

1176 $^6Li(^3He,p + 2\alpha)$ REACTION. Gagne, Robert Maurice. Washington, D. C.; Georgetown Univ. (1971). 161p. University Microfilms Order No. 71-19,327.

Thesis.

The decay of the $^6Li(^3He, p + 2\alpha)$ reaction at incident ^3He energies of 1.5 and 1.65 MeV was observed to be sequential in character. The states observed in the experiment are the ground (0^+), 2.9-MeV (2^+), 16.6-MeV (2^+), and 16.9-MeV (2^+) of ^8Be and the ground state ($^3/_2^-$) of ^5Li. The dominant mode of decay is through the 16-MeV states of ^8Be. Angular correlation data on the decay of the $2.9(2^+)$ state of ^8Be was obtained at proton first emitted angles of $\theta_1 = 90°$ and 70° as a function of second emitted alpha particle angle θ_2. The angular correlation function exhibited symmetry axes consistent with a two-mode, i.e., stripping and knockout, direct reaction mechanism. (Diss. Abstr. Int., B)

1177 EVIDENCE FOR LARGE-MOLECULAR-CLUSTER FORMATION OF NUCLEAR REACTION RECOILS THERMALIZED IN HELIUM. Jungclas, H.; Macfarlane, R. D.; Fares, Y. (Texas A and M Univ., College Station). Phys. Rev. Lett.; 27: No. 9, 556-7(30 Aug 1971).

It has been found that nuclear reaction recoils ejected from a target and thermalized in helium attach to large molecular clusters produced from impurities by the intense ionization generated by the beam passing through helium. When the clusters containing the recoils are entrained in a room-temperature sonic helium flow, they attain kinetic energies of up to 700 keV on account of their high molecular weights which were found to be as high as 10^8 u. Highly efficient separations of nuclear reaction recoils from helium carrier gas have been achieved as a result of the formation of these large clusters. (auth)

1178 TENSOR FORCES IN PAIRING INTERACTION OF NUCLEONS IN ^{16}N AND ^{16}F NUCLEI. Baktyubaev, K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 73-6(Nov-Dec 1970). (In Russian).

The rate of tensor forces in pair interaction of nucleons was examined for ^{16}N and ^{16}F. Parameters were determined for the general expression of the residual interaction. The properties of matrix elements of tensor forces were shown to be significant for some configurations. (tr-auth)

1179 TENTATIVE METHODS FOR ESTIMATING THE THERMAL NEUTRON ABSORPTION CROSS SECTION OF NUCLEAR GRAPHITE. ASTM C626-68T. Philadelphia; American Society for Testing and Materials (1968). 2p. Available from American Society for Testing and Materials, Philadelphia.

Three methods of estimating the thermal (2200-m/sec) neutron absorption cross section of nuclear graphite are given; these are referred to as boron and ash, common impurities, and DIH purity. These methods apply to graphites to be used for moderator or reflector components of nuclear reactors and subcritical test reactors and for thermal columns. Excluded from these methods are graphites containing fissionable materials for use as fuel or driver elements and graphites containing materials having high neutron absorption cross sections for use as reactor control or safety devices. (R.W.R.)

1180 PHASE SHIFT ANALYSIS OF $^{12}C(\alpha,\alpha_0)^{12}C$ CROSS SECTIONS FROM 4.0 TO 13.3 MeV AND THE STATES OF ^{16}O. Marvin, Thomas Phillip. Bloomington, Ind.; Indiana Univ. (1971). 117p. University Microfilms Order No. 71-21,286.

Thesis.

The natural-parity levels of ^{16}O from 10.0 to 17.1 MeV excitation were investigated via a phase-shift analysis of $^{12}C(\alpha,\alpha_0)$ ^{12}C cross sections. The cross sections covered the range of 15° to 170° in the laboratory system in 3° or 5° intervals. These distributions were obtained in 15- to 50-keV increments over the bombarding energy range of 4 to 13.3 MeV. Excitation functions over the entire energy range at the zeroes of Legendre polynomials up to order six were obtained. These curves demonstrate characteristic anomalous shapes at many energies, and are used to aid in identifying the spins and parities of many levels in ^{16}O. In addition, the angular distributions were integrated over the range of 30° to 165° at each energy to produce a "total" cross section curve. This curve also demonstrates several broad peaks, which can be correlated with resonance positions in ^{16}O. It was possible to perform a complex phase-shift analysis, which had eight partial waves in the expansion. By applying a resonance formalism to the results of the phase-shift analysis, the positions, partial widths, and spins and

parities of many levels in ^{16}O were obtained. In addition to confirming the existence of many well known levels, this work has resulted in a substantial clarification of the ^{16}O energy level scheme. Several other levels previously observed are shown not to exist, and the existence of many others was cast into considerable doubt. Modifications in the level scheme resulting from this work are interpreted in the framework of recent theoretical calculations in ^{16}O. (TSS)

1181 STUDY OF T = 1 STATES IN MASS 18 USING THE $^{16}O(^3He,n)^{18}Ne$ REACTION. Nero, Antonio Vincent Jr. Stanford, Calif.; Stanford Univ. (1971). 122p. University Microfilms Order No. 71-19,735.

Thesis.

The $^{16}O(^3He,n)^{18}Ne$ reaction was used to investigate particle-unbound states in ^{18}Ne. Incident laboratory energies ranged from 10 to 22 MeV, and neutrons were observed with a time-of-flight spectrometer. States were seen at excitation energies of 4.51, 4.59, 5.09, 5.15, 6.29, 7.06, 7.71, 7.92, 8.10, and 8.50 MeV. Resolution of the two states at 5.1 MeV and existence of the states at 7.06, 7.71, 8.10, and 8.50 MeV have not been reported previously. Angular distributions of the stronger neutron groups are compared with results of calculations of double stripping cross sections by using the distorted-wave Born approximation to obtain the following probable spin and parity assignments: 0^+ (with 1^- possible) for 4.59-MeV state, 3^- for one member of the 5.1-MeV doublet, 2^+ or 1^- for the 7.06-MeV state, and 1^- or 2^+ for the 7.92-MeV state. The strongly populated state at 7.06 MeV may be dominated by configurations involving the $d_{\frac{5}{2}}$ orbital. Results of this work, γ-ray studies of the bound states, and $^{20}Ne(p,t)$ angular distributions to the 4.5 MeV doublet are used to establish a ^{18}Ne level diagram similar to that of ^{18}O for this region. The most striking difference is that the third 0^+ state is 0.75 MeV lower in excitation in ^{18}Ne than in ^{18}O. A model for calculating the relative positions of analogous levels in ^{18}O and ^{18}Ne is presented. Shifts are expected to occur because of the additional Coulomb force introduced by turning the last two neutrons in ^{18}O into protons to obtain ^{18}Ne. It is found that these shifts should depend strongly on the excitation energies and configurations of particular states, as a result of which experimentally observed relative energies can be used to choose among the various shell-model calculations of T = 1 states in mass 18. With this model for Coulomb shifts, it is found that the wave-functions of Benson and Flowers reproduce the experimental shifts. (Diss. Abstr. Int., B)

1182 MOMENTS OF INERTIA OF LIGHT NUCLEI. Grin, Yu. T.; Leinson, L. B. Yadern. Fiz.; 14: No. 1, 96-103(Jul 1971). (In Russian).

A formula for the moment of inertia in the model of induced rotation is obtained by means of the wave functions used in the K-harmonics method. The numerical results for ^{12}C, ^{16}O, and ^{20}Ne are compared with experiment. (auth)

1183 ELASTIC SCATTERING OF POLARIZED DEUTERONS BY ^{12}C, ^{19}F, ^{40}Ca NUCLEI. Borovlev, V. I.; Slabospitskii, R. P.; Klyucharev, A. P.; Andreev, G. B.; Lopatko, I. D. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 14: No. 1, 47-53(Jul 1971). (In Russian).

The parameters of the vector analyzing capacity $\langle iT_{11}\rangle$ in elastic deuteron scattering on ^{12}C, ^{19}F, ^{40}Ca nuclei were measured using a polarized deuteron beam. The measurements are performed at the scattering angles $\theta_{l.s.}$ = 70 and 90° and within the incident deuteron energy region 1.6 to 3.0 MeV. It follows from the measurements that the elastic d + ^{12}C scattering can be used as an analyzer of the deuteron vector polarization; the vector analyzing capacity of the reaction $^{40}Ca(d,d)^{40}Ca$ in the given energy region of incident deuterons is zero; the nonzero $\langle iT_{11}\rangle$ at elastic d + ^{19}F scattering at E_d = 2.1 to 2.3 MeV has a resonance character and seems to be due to the presence of an intermediate structure in the ^{21}Ne nucleus. (auth)

1184 YIELDS AND CROSS SECTIONS FOR PRODUCTION OF GAMMA RAYS FROM BOMBARDMENT OF C, Al, AND Ni TARGETS BY 1.5- TO 6.4-MeV PROTONS. Bibichev, B. A.; Biryukov, E. I.; Dudkin, V. E.; (and others). At. Energ. (USSR); 31: No. 1, 68-70(Jul 1971). (In Russian).

The spectra, yields, and cross sections for γ-quanta formation were experimentally measured for the bombardment of C, Al, and Ni targets by protons which ranged in energy from 1.5 to 6.4 MeV. The gamma spectrum from a thick Al target and 6.36 MeV protons is plotted. Various tables present the data sought. (K.S.W.)

1185 YIELDS OF ^7Be FROM THE IRRADIATION OF Li AND B BY PROTONS OR DEUTERONS, AND FROM THE IRRADIATION OF Be BY PROTONS, DEUTERONS, OR α-PARTICLES. Dmitriev, P. P.; Krasnov, N. N.; Molin, G. A.; Panarin, M. V. At. Energ. (USSR); 31: No. 2, 157-9(Aug 1971). (In Russian).

The production of the isotope ^7Be with a half life of 53 days has been published by a number of authors, but the combined data are inconsistent and incomplete. Accordingly Li and B targets were irradiated with protons and deuterons, and Be targets with protons, deuterons, and α-particles. The results were tabulated and compared with prior values from the literature. (K.S.W.)

1186 EXCITED STATE OF ^{12}C AT 16.11 MeV. Goulard, G. (Laval Univ., Quebec). Lett. Nuovo Cim.; 2: No. 8, 397-401(21 Aug 1971). (In French).

Parameters for the 16.11-MeV level in ^{12}C, as obtained from the $^{11}B(p,\alpha)2\alpha$ reaction at 0.163 MeV, are discussed. Published values are used to calculate excitation functions for the reaction. Although the shapes agree well with experimental results, the absolute values are incorrect by an order of magnitude; it is suggested that a value of 7 eV for the proton width, instead of 70 eV, would reconcile the discrepancy. (R.W.R.)

1187 FAST PHOTONEUTRONS FROM LIGHT AND MEDIUM NUCLEI. Costa, S. (Univ., Turin); Ferrero, L.; Pasqualini, L.; Mancini, E. Lett. Nuovo Cim.; 2: No. 13, 665-8(25 Sep 1971).

Photoneutron cross sections for several nuclei from A = 9 to 96 were measured at E_γ = 36 to 64 MeV and compared with predictions of the quasideuteron absorption model. The data are compared with calculations made using a Monte Carlo technique. (J.W.R.)

1188 PROPERTIES OF HIGHLY EXCITED STATES OF ^{16}O PRODUCED IN REACTION $^{12}C(^6Li,d)^{16}O$. Artemov, K. P.; Gol'dberg, V. Z.; Petrov, I. P.; (and others) (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 14: No. 2, 292-6(Aug 1971). (In Russian).

Angular correlation of deuterons and α-particles from ^{16}O decay is measured from states with the excitation energy of 16.2 MeV and in the region of 14.3 to 14.7 MeV in the reaction $^{12}C(^6Li,d)^{16}O \rightarrow {}^{12}C_{ground} + \alpha$. It is established that spin and parity of a highly excited level near 16.2 MeV are equal to 6^+; the parity of the most intensively populated state in the region of 14.3 to 14.7 MeV is negative. A small probability of the deuteron spin flip is noted as an interesting property of the investigated reaction. (auth)

1189 STRUCTURE OF THE CROSS SECTION OF THE REACTION $^{12}C(\gamma,n)$ IN THE GIANT DIPOLE RESONANCE REGION. Ishkhanov, B. S.; Kapitonov, I. M.; Piskarev, I. M.; Shevchenko, V. G. (Moscow State Univ.). Yadern. Fiz.; 14: No. 2, 253-60 (Aug 1971). (In Russian).

The yield curve of the reaction $^{12}C(\gamma,n)$ was obtained in the γ-quanta energy region 19.0 to 24.0 MeV in 20-keV steps. The effective cross section calculated with the yield curve has 12 resonances. Comparing the experimental data with the theoretical calculations one concludes that in the considered energy region the experimental cross section has a much more complicated structure. (auth)

1190 INVESTIGATION OF THE REACTION $^{12}C(p,^6Li)^7Be$ AT 36 TO 57 MeV. Holman, A. B. (Univ. of California, Los Angeles); Perrenoud, Jean-Luc; Young, J. C.; (and others). Nucl. Phys.; A174: No. 1, 161-72(1971).

Differential cross sections for the reaction $^{12}C(p,^6Li)^7Be$ (g.s. + 0.431 MeV) have been measured at incident proton energies of 36.0, 40.7, 45.0, 50.0 and 56.8 MeV. Angular distributions are presented for the c.m. angles generally between 20 and 160°. At the lowest energy differential cross sections are as large as 200 μb/sr. Excitation functions have been taken at energies from 36 to 43 MeV at the c.m. angles 37, 67 and 90°. The data have been analyzed using zero-range and finite-range DWBA theories assuming the pickup of ^5He and ^6Li clusters as the dominant reaction mechanisms. (auth)

1191 MAGNETIZATION DISTRIBUTION OF THE ^7Li NUCLEUS AS OBTAINED FROM ELECTRON SCATTERING THROUGH 180°. THE ELECTRIC QUADRUPOLE MOMENT OF ^7Li. Van Niftrik, G. J. C.; Lapikas, L.; De Vries, H.; Box, G. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Phys.; A174: No. 1, 173-92(1971).

Cross sections for scattering of electrons from the ground state doublet of ^7Li have been measured in the energy range of 25 to 90 MeV with an energy resolution better than 200 keV. From the cross sections for transverse elastic scattering measured at 180° the rms radius of the ground state magnetization density distribution has been determined: $\langle r^2\rangle^{\frac{1}{2}}_M = 2.98 \pm 0.05$ fm. The value of the reduced transition probability for M1 excitation of the first excited level has been determined from the ratio of transverse inelastic and elastic cross sections at 180°. The result [B(M1,↑; 478 keV) = $2.50 \pm 0.12\ \mu_N^2$] agrees very well with the result of lifetime measurements. The cross sections for longitudinal (C2) excitation of this level have been extracted from scattering through angles of

90 to 150°. The measured reduced transition probability [B(C2,↑ 478 keV) = 7 ± 4 fm⁴] is compared with the values obtained by several other experimental methods. In a shell-model analysis the data can be considered to measure the size of the 1p shell. The resulting value (a_{1p} = 1.90 ± 0.03 fm) is much larger than the one determined from earlier electron scattering experiments, where the 478 keV level was not resolved. A relative measurement of the longitudinal elastic scattering from ^{7}Li and from ^{6}Li showed no isotopic effect on the rms charge radius: $\langle r^2\rangle_7^{\frac{1}{2}}/\langle r^2\rangle_6^{\frac{1}{2}}$ = 1.001 ± 0.008. Accepting the measured rms charge radius for ^{6}Li this corresponds to $a_{1s} = a_{1p}$ = 1.90 fm for ^{7}Li reconfirming the above value. The data are compared with shell-model and projected Hartree–Fock calculations. (auth)

1192 GROUND STATE OF ^{6}Li. Hasegawa, Akira (Saga Univ., Japan); Nagata, Sinobu. Progr. Theor. Phys. (Kyoto); 45: No. 6, 1786-1807(Jun 1971).

The alpha-deuteron cluster structure of the ground state of ^{6}Li is investigated by solving the coupled equation for the relative motion between the clusters. The equation is derived by using the resonating group method and taking into account the D-state of the deuteron cluster. Realistic two-nucleon potentials are employed consistently to explain the total binding energy, the relative binding energy between the clusters, the root-mean-square radius and the elastic charge form factor. It is shown that the essential feature of the relative motion is very sensitive to the odd state potential and the tensor force. Fairly good wave functions for the relative motion are obtained and the nodal behavior of these wave functions is discussed. (auth)

1193 ANALYSIS OF $_{12}$C(p,2p) AND $_{12}$C(e,e'p) REACTIONS AT HIGH ENERGIES. Shanta, R.; Jain, B. K. (Bhabha Atomic Research Centre, Trombay, India). Nucl. Phys.; A175: No. 2, 417-27(1971).

The (p,2p) reaction data at 460 MeV and 1 GeV incident proton energies and (e,e'p) data around 600 MeV incident electron energy on ^{12}C are analyzed using the phenomenological Elton–Swift wave function [Nucl. Phys., A94: 52(1967)] and the projected Hartree–Fock (PHF) wave function [Nucl. Phys., A120: 135(1968)] for the bound proton. For the (p,2p) reaction the distorted-wave impulse approximation (DWIA) is used, while the (e,e'p) data are analyzed using the McVoy and Van Hove form for the electron–proton interaction [Phys. Rev., 125: 1034(1967)] and distorted waves for the outgoing proton. It is found that the predicted cross section agrees with the experimental cross section for the (p,2p) reaction at the two energies and with the cross section for the knockout of a 1s proton in the (e,e'p) reaction. The computed 1p momentum distribution for the (e,e'p) reaction peaks at higher momentum than the corresponding experimental distribution. (auth)

1194 MULTI-CONFIGURATION HARTREE–FOCK CALCULATION IN ^{12}C. Faessler, Amand (Univ., Muenster, Ger.); Schmid, K. W.; Plastino, A. Nucl. Phys.; A174: No. 1, 26-36 (1971).

The multi-configuration Hartree–Fock (MCHF) theory, a variational method for the self-consistent solution of the nuclear many-body problem with the inclusion of correlations, is applied to ^{12}C. The force is the Yale potential in the form of the Yale–Shakin matrix elements. 40 different configurations are included. The gain in the total binding energy compared to HF in the same single-particle basis and with the same force is 1.20 MeV. The MCHF theory yields the first excited 0^+ state and the first excited 2^+ state in good agreement with the experimental data. (auth)

1195 ^{6}Li FORM FACTORS IN THE REFINED CLUSTER MODEL. Stoewe, Heinz; Hackenbroich, Hans H.; Hutzelmeyer, Hannes (Univ., Cologne). Z. Phys.; 247: No. 2, 95-106(1971).

A soft-core central potential is used to calculate independently ^{6}Li ground state and excited state wave functions in the refined cluster model. Charge density, elastic form factor and transition form factor to the 3^+ state are derived and agree reasonably well with experiment. (auth)

1196 TOTAL CROSS-SECTION MEASUREMENTS FOR ^{14}N(α,γ)^{18}F. Couch, R. G.; Spinka, H.; Tombrello, T. A.; Weaver, T. A. (California Inst. of Tech., Pasadena). Nucl. Phys.; A175: No. 2, 300-8(1971).

Cross section measurements were made for the ^{14}N(α,γ)^{18}F reaction for $0.5 \leqq E_\alpha \leqq 1.2$ MeV. A new resonance, corresponding to the 4.849-MeV state in ^{18}F, was found at E_α(lab) = 0.56 MeV. The quantity $(2J+1)\Gamma_\alpha\Gamma_\gamma/\Gamma$ was determined to be $(2.79 \pm 0.5) \times 10^{-4}$ eV and 0.108 ± 0.015 eV for states at E_α = 0.56 and 1.14 MeV, respectively. From a theoretical calculation of the cross section for direct radiative capture and an extrapolation of the tails of the measured resonances to E_α = 0.0, a value S ≈ 0.7 MeV · b is estimated for the nonresonant S-factor. The astrophysical significance of the ^{14}N(α,γ)^{18}F reaction is discussed; and the reaction rate, $N_A\langle\sigma v\rangle$, is calculated for temperatures $0.01 \leqq T_9 \leqq 1.0$. The rate is accurately determined by the experimental measurements for $T_9 > 0.09$. (auth)

1197 ELASTIC SCATTERING OF ^{4}He FROM ^{6}Li AND ^{7}Li AT 12.0 TO 18.5 MeV. Bingham, H. G.; Kemper, K. W.; Fletcher, N. R. (Florida State Univ., Tallahassee). Nucl. Phys.; A175: No. 2, 374-84(1971).

An optical-model analysis is applied to measured angular distributions of α particles elastically scattered by ^{6}Li and ^{7}Li at several bombarding energies between 12.0 and 18.5 MeV. The optical model gives a good representation of the data when a target spin–orbit potential, $V_{l\cdot l}$, is included. With $V_{l\cdot l} \neq 0$, a large interaction radius, ≈3.5 fm, for the real potential is preferred over a smaller radius of ≈2.5 fm. (auth)

1198 LIFETIME OF THE 3.06 MeV EXCITED STATE OF ^{18}F. Lebrun, C. (Univ., Nantes, France); Guilbault, F.; Deschamps, Y. Compt. Rend., Ser. B; 273: No. 1, 41-4(5 Jul 1971). (In French).

The ^{17}O(d,n)^{18}F reaction leads to the 3.06-MeV excited level of ^{18}F. A coincidence technique was used to select the nucleus recoil direction and allowed the study of the level lifetime to be made, by using Doppler effect. The limiting value found is in good agreement with Benson and Flowers' theoretical results; in particular, with the prediction of an isospin effect for the M1 transitions. (France)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 143, 1154, 1155, 1157, 1158, 1167, 1174, 1182, 1183, 1184, 1187, 1302, 1380, and 1397.

1199 (BNWL-1604) PACIFIC NORTHWEST LABORATORY ANNUAL CONTROLLED THERMONUCLEAR REACTOR TECHNOLOGY REPORT, 1971. Wolkenhauer, W. C. (ed.) (Battelle Pacific Northwest Labs., Richland, Wash.). 30 Jun 1971. Contract AT(45-1)-1830. 108p. Dep. NTIS.

ALUMINUM-27—neutron reactions (n,α) and (n,p) with, reaction rates for foil in graphite pile
COPPER-63—neutron capture by, reaction rate for foil in graphite pile
COPPER-65—neutron reactions (n,2n) with, reaction rate for foil in graphite pile
DEUTERIUM—deuteron reactions (d,p) at 10 keV to 10 MeV, multi-parameter analysis of
—reactions with niobium–zirconium alloys at 900°C, absorption kinetics for
GOLD-197—neutron reactions (n,γ) and (n,2n) with, reaction rates for foils in graphite pile
GRAPHITE—neutron slowdown in, comparison of calculated and experimental data for 14-MeV
HYDROGEN—reactions with niobium–zirconium alloys at 900°C, absorption kinetics for
MAGNESIUM-24—neutron reactions (n,p) with, reaction rate for foil in graphite pile
MANGANESE-55—neutron capture by, reaction rate for foil in graphite pile
MOLYBDENUM—radiation effects on, from heavy-ion bombardment
NEUTRONS, FUSION—reactions with blanket materials, calculations for
NIOBIUM—radiation effects on, from heavy-ion bombardment
NIOBIUM ALLOYS AND SYSTEMS—Nb–Zr, reactions with hydrogen and deuterium at 900°C, absorption kinetics for
THERMONUCLEAR REACTORS—neutron physics calculations for blanket materials
TITANIUM-48—neutron reactions (n,p) with, reaction rate for foil in graphite pile
TRITIUM—deuteron reactions (d,n) at 10 keV to 10 MeV, multi-parameter analysis of
TZM (MOLYBDENUM ALLOY)—radiation effects on, from heavy-ion bombardment
VANADIUM—radiation effects on, from heavy-ion bombardment

1200 (CONF-710301-(Vol.1), pp 179-83) NEUTRON TOTAL CROSS SECTION OF ^{16}O AND ^{40}Ca. Fowler, J. L.; Johnson, C. H.; Haas, F. X.; Feezel, R. M. (Oak Ridge National Lab., Tenn.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The $^{7}Li(p,n)$ reaction produced by monoenergetic protons on thin lithium targets served as a neutron source to measure the cross section of ^{40}Ca from 1.0 to 2.1 MeV with 4 keV resolution, and from 0.82 to 1.8 MeV with 2 keV resolution. In the common region from 1.0 to 1.8 MeV there were 45 peaks seen with 4 keV resolution and about twice as many with 2 keV. The ^{16}O cross section measured previously with $^{7}Li(p,n)$ neutrons was extended to 4.34 MeV with about 5 keV resolution. Since the correction for the second group of neutrons from the $^{7}Li(p,n)$ source becomes large at these higher energies, the ^{16}O cross section was remeasured with T(p,n) neutrons from 1.75 to 4.35 MeV with 30 keV resolution. Results for the two sources agree except near narrow resonances. In particular, the s-wave minimum at 2.35 MeV is 0.13 b for the $^{7}Li(p,n)$ source and, corrected for resolution, 0.134 b for the T(p,n) source. Recent $^{7}Li(p,n)$ data show the ^{16}O resonance at 3.765 MeV has $J = 1/2$. (auth)

1201 (CONF-710301–(Vol.1), pp 191-5) HIGH RESOLUTION INELASTIC CROSS SECTION MEASUREMENTS FOR Na, Si, AND Fe. Perey, F. G.; Kinney, W. E.; Macklin, R. L. (Oak Ridge National Lab., Tenn.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A program of inelastic scattering measurements has been initiated at ORELA. Data are obtained by detecting the de-excitation gamma rays in a 4π geometry with a flight path of 40 meters. The present detector is a hydrogen-free carbon fluoride liquid scintillator used in capture cross section measurements. The initial set of measurements was performed with only 0.125 nsec/meter resolution to investigate the technique. Data were reduced up to the threshold of the second excited state for ^{7}Li, C, Na, Si, and Fe. The carbon data were used for a background determination and the ^{7}Li data for flux determination. The data for Na, Si, and Fe are presented. The cross sections show great resonance structure with peak-to-valley ratios larger than those found in the total cross section. The energy resolution is sufficient to identify all the resonances observed in the inelastic cross sections with resonances in the total cross sections. Various aspects of the experimental technique are discussed. (auth)

1202 (CONF-710301–(Vol.1), pp 196-201) INELASTIC NEUTRON SCATTERING CROSS SECTIONS IN SEVERAL ELEMENTS WITH 14.1-MeV NEUTRONS. Voignier, J.; Clayeux, G.; Bertrand, F. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The energy spectra of scattered neutrons from Mg, Al, Si, S, Ca, Sc, Fe, Ni, Cu, Au, Pb, Bi, ^{235}U, ^{238}U and ^{239}Pu have been measured in the energy range 100 keV–7 MeV. Data were taken using conventional time-of-flight techniques. The values obtained for the various differential cross sections are compared with previous results. (auth)

1203 (CONF-710301-(Vol. 1), pp 202-17) STUDY OF THE $^{56}Fe(n,n'\gamma)$ REACTION BETWEEN 2.5 AND 14.1 MeV. Haouat, G.; Lachkar, J.; Patin, Y.; Sigaud, J. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The electromagnetic decay following the inelastic scattering of neutrons on ^{56}Fe was studied at the energies: $2.50 \pm 0.05 - 4.80 \pm 0.10 - 5.30 \pm 0.10 - 5.80 \pm 0.10 - 6.30 \pm 0.05 - 6.80 \pm 0.05 - 7.30 \pm 0.05 - 7.80 \pm 0.05 - 8.30 \pm 0.05 - 8.80 \pm 0.05 - 14.10 \pm 0.03$ MeV. Starting from the study of the β^{+} disintegration of ^{56}Co the level scheme of ^{56}Fe was completed: about sixty levels seen, twenty of them not yet observed in this mode of investigation. That has been possible thanks to the good energy resolution in measuring the γ-rays. Cross sections of the main γ-rays (0.847–1.038–1.239–1.810–2.113–2.274–2.523–2.600–3.448–3.600 MeV) and angular distributions have been recorded and compared to the results already published. A computer program based on the compound nucleus hypothesis in the HAUSER–FESHBACH formalism and including the MOLDAUER width fluctuations enables the fit of the experimental results between 2 and 9 MeV. At higher energies, the direct interaction mechanism must be taken into account. (auth)

1204 (CONF-710301-(Vol. 1), pp 218-26) MEASUREMENT OF HIGH RESOLUTION γ-RAY PRODUCTION CROSS SECTIONS IN INELASTIC NEUTRON SCATTERING ON Al AND Fe BETWEEN 0.8 TO 13 MeV. Voss, F.; Cierjacks, S.; Kropp, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Differential cross sections for the production of γ-rays by $(n,n'\gamma)$ reactions in aluminum and iron have been measured at 125° as a function of the incident neutron energy from 0.8–13 MeV. The Karlsruhe isochronous cyclotron was used to produce a pulsed beam of neutrons having a continuous energy spectrum from ~0.5–30 MeV. The γ-ray energies were measured using a Ge(Li) detector. The incident neutron energies were determined by the time-of-flight technique. The energy resolution obtained in this measurement was ≤1.7 keV at 0.8 MeV and ≤110 keV at 13 MeV, respectively. Neutron flux determination was accomplished by use of a calibrated proton recoil detector. Below approximately 3 MeV our results can be used to determine inelastic scattering cross sections for the excitation of six levels in aluminum and five levels in iron. A comparison of the presented results with other available data is shown and discussed. (auth)

1205 (CONF-710301-(Vol. 1), pp 227-34) Fe AND Al$(n,x\gamma)$ CROSS SECTIONS FROM 0.86 TO 16 MeV NEUTRON ENERGY. Hoot, C. G.; Orphan, V. J.; John, Joseph (Gulf Radiation Technology, San Diego, Calif.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The $(n,x\gamma)$ cross sections for Fe and Al have been measured using an electron LINAC pulsed neutron source. The γ-rays were detected with an 80-cm^3 Ge(Li) detector, and the neutron energy E_n was determined by the time-of-flight technique. The two-parameter data were accumulated using an on-line computer. Integrated cross sections were deduced from differential cross sections measured at ~125°. The cross sections obtained include high neutron energy resolution data for the strongest lines and grouped (ΔE_n from 0.15 to 2 MeV) data for other lines. With a 51-m flight path and a 20-nsec LINAC burst width, a neutron resolution of ~1% at 1 MeV was obtained. High resolution $(n,n'\gamma)$ data obtained for the 847-keV line from ^{56}Fe and for the 1013-keV line from ^{27}Al display considerable structure. Comparisons with previous measurements made with monoenergetic sources are given. Also, grouped data for lines plus continuum have been obtained by spectrum unfolding for ~250-keV wide γ-ray energy bins. (auth)

1206 (CONF-710301-(Vol. 1), pp 235-40) Ca$(n,x\gamma)$ REACTION AT $E_n = 5.9$ MeV. Dickens, J. K.; Perey, F. G. (Oak Ridge National Lab., Tenn.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Gamma-ray production cross sections have been measured for 5.9 MeV neutrons interacting with calcium. Cross-section data are in reasonable agreement with previously reported neutron inelastic scattering cross sections. (auth)

1207 (CONF-710301–(Vol.1), pp 267-72) RADIATIVE CAPTURE OF 14-MeV NEUTRONS IN Cu, Zr, AND Sb. Stamatelatos, M.; Lidofsky, L. J.; Lawergren, B. (Columbia Univ., New York).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

14 MeV (n,γ) cross sections and high energy gamma ray spectra were measured for Cu, Zr and Sb. A coincidence-anticoincidence telescope-pair-spectrometer was used to detect and determine the energy of capture gammas. The resultant gamma spectra were compared with theoretical model predictions. Calculations using the semi-direct (collective) capture model yielded reasonable agreement in shape and magnitude. Cross sections obtained by integrating the gamma spectra for energies $E_\gamma > 14$ MeV agreed with the values from previous activation measurements. It was concluded that a significant portion of the gamma spectrum following radiative capture of 14 MeV neutrons corresponds to decays directly to bound levels. (auth)

1208 (CONF-710301-(Vol. 1), pp 299-305) EXCITATION CURVES FOR THE REACTIONS $^{64}Zn(n,p)^{64}Cu$, $^{68}Zn(n,\alpha)^{65}Ni$, AND $^{70}Zn(n,2n)^{69m}Zn$. Santry, D. C.; Butler, J. P. (Atomic Energy of Canada Ltd., Chalk River (Ontario)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Cross sections for the reaction of fast neutrons with zinc have been measured by the activation method from threshold energies up to 20 MeV. Monoenergetic neutrons were produced with a tandem accelerator using the reactions $T(p,n)^{3}He$, $D(d,n)^{3}He$ and $T(d,n)^{4}He$. At neutron energies below 5.5 MeV the neutron flux was measured with a calibrated neutron long counter, while at higher energies cross section values for the zinc reactions were measured relative to the known cross section for the reaction $^{32}S(n,p)^{32}P$. The suitability of the $^{64}Zn(n,p)^{64}Cu$ reaction as a standard for fast-neutron flux monitoring of a reactor spectrum is examined. (auth)

1209 (CONF-710301-(Vol. 1), pp 318-24) USE OF ELECTRON LINAC FOR MEASURING $(n,x\gamma)$ REACTION CROSS SEC-

TIONS WITH A C II 10 020 ON-LINE COMPUTER. Lucas, G.; Bertin, A. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

(n,xγ) reaction cross section measurements have been made in the energy range of from 1 to 10 MeV. An electron linear accelerator (LIMEIL LINAC) is used to produce a beam of pulsed neutrons. The two-parameter data (En,Eγ) acquisition has been made with a C II 10 020 on line computer. The essential features of the experimental layout are described and cross sections of gamma ray production resulting from the neutron bombardment of iron, aluminum and bismuth are given. (auth)

1210 (CONF-710301-(Vol.2), pp 757-63) EFFECTIVE NEUTRON CAPTURE CROSS SECTION OF ^{58}Co. Santry, D. C.; Werner, R. D. (Atomic Energy of Canada Ltd., Chalk River (Ontario)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

^{58}Co activity was ion implanted into high purity aluminum foil and used to measure the neutron capture cross section by the depletion method using high resolution gamma-ray spectrometry. An effective cross section value of 1955 ± 117 barns was measured relative to a ^{59}Co cross section of 37.09 barns. (auth)

1211 (CONF-710301-(Vol.2), pp 771-7) THRESHOLD PHOTONEUTRON EXPERIMENTS AT THE ANL HIGH-INTENSITY LINAC. Jackson, H. E.; Strait, E. N. (Argonne National Lab., Ill.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A program of threshold photoneutron studies has begun at a new high-resolution facility. Measurements emphasize problems which, in the past, have been studied in resonance neutron capture—i.e., determination of resonance spins and parities, ground-state radiation widths, and radiative strength functions. Data for ^{57}Fe(γ,n) are presented to illustrate capabilities of the technique and facility. (auth)

1212 (CONF-710301-(Vol.2), pp 778-84) AVERAGED keV NEUTRON CAPTURE IN ZINC. Bird, J. R.; Kenny, M. J.; Musgrove, A. R. de L.; Allen, B. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Averaged gamma ray transitions strengths in ^{65}Zn and ^{67}Zn were measured after neutron capture in the kilovolt energy region. These results are compared with calculations based on resonance parameters and a statistical neutron capture mechanism. Estimates of the p- and d-wave strength functions are obtained. Because of the substantial deviation from statistical behavior of averaged transitions strengths, it is apparent that configuration effects play an important role in the partial neutron capture cross sections. (auth)

1213 (CONF-710301-(Vol.2), pp 882-8) EXCITED STATES OF ^{56}Fe POPULATED IN THE BETA DECAY OF ^{56}Mn. Singh, Jag J. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The gamma ray spectrum following the decay of ^{56}Mn has been measured using Ge(Li) counters. On the basis of the relative intensities of the observed gamma rays, the fractional beta decays to the various ^{56}Fe states have been calculated to be as follows: 54.97% (0.846 MeV), 28.29% (2.658 MeV), 15.29% (2.959 MeV), and 1.17% (3.370 MeV). The presence of a weak 1.238 MeV γ ray indicates a weak (0.28 ± 0.20%) beta decay to the 2.085 MeV state. No definite evidence for a branch to the 3.445 MeV state has been found. (auth)

1214 (FRNC-TH-45) STUDY OF THE ^{42}Ca–^{42}K AND ^{46}Ca–^{46}K NUCLEI USING TRANSFER REACTIONS. Dupont, Yves (Grenoble Univ. (France)). 1971. 94p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Isotopes of calcium and potassium with a mass number A = 42 were studied using the reactions ^{43}Ca(p,d)^{42}Ca, ^{44}Ca(p,t)^{42}Ca, and ^{44}Ca(p,^{3}He)^{42}K. The levels of ^{42}Ca were analyzed up to an excitation energy of 13 MeV, and new values for the spins were obtained. The configurations of a large number of states were determined using the DWBA for the (p,d) and (p,t) reactions. ^{42}K was studied using the analog states observed in ^{42}Ca with the ^{44}Ca(p,^{3}He)^{42}K reaction. ^{48}Ca(p,t)^{46}Ca reactions were used to study the level scheme of ^{46}Ca up to an excitation energy of 16 MeV; numerous spins were also determined. Observation of T = 4 analog states and the study of the ^{48}Ca(p,^{3}He)^{46}K reaction led to the first determination of the spin sequence of the first ^{46}K states. A synthesis of the results obtained is presented, which allows the analog states in the calcium isotopes to be predicted, and a level scheme for ^{44}K to be proposed. By using the difference between the Coulomb energies, information on the variations in the nuclear radius as the $f_{\frac{7}{2}}$ shell fills up was obtained. A value is suggested for the mass of the ^{46}Ar nucleus. (auth) (France)

1215 NUCLEAR STRUCTURE OF ^{22}Na. Garrett, Jerry Dale. Philadelphia; Univ. of Pennsylvania (1970). 193p. University Microfilms Order No. 71-19,227.

Thesis.

The nuclear structure of ^{22}Na was studied using the ^{21}Ne(^{3}He,d) ^{22}Na($E_{^3He}$ = 18 MeV), ^{23}Na(^{3}He,α)^{22}Na($E_{^3He}$ = 18 MeV), ^{20}Ne(^{3}He,p) ^{22}Na($E_{^3He}$ = 15 MeV), ^{20}Ne(^{6}Li,α)^{22}Na($E_{^6Li}$ = 18 MeV), and ^{12}C(^{14}N,α) ^{22}Na($E_{^{14}N}$ = 30 MeV) reactions. The reaction products were magnetically analyzed with a multiangle magnetic spectrograph. The systematics of the (^{3}He,d), (^{3}He,α), (^{3}He,p), and (^{6}Li,α) angular distributions allow assignment of transferred angular-momentum values resulting in several new spin–parity assignments. A comparison of the spectra of the reactions performed reveals that known T = 1 states are weakly excited in the ^{20}Ne(^{6}Li,α) and ^{12}C(^{14}N,α) reactions. Several candidates for previously unreported T = 1 states are suggested from a comparison of the ^{20}Ne(^{3}He,p) and ^{20}Ne(^{6}Li,α) studies and from the known level scheme of ^{22}Ne. Distorted-wave predictions were compared with the ^{21}Ne(^{3}He,d) and ^{23}Na(^{3}He,α) angular distributions that are characteristic of single-particle transfer. The resulting extracted spectroscopic factors were compared with spectroscopic factors calculated using the Nilsson model and with other experimental single-particle transfer spectroscopic factors leading to final states in mass 22. Two-particle distorted-wave calculations based on a description of the ^{22}Na levels in terms of two-particle Nilsson states with associated rotational bands were compared with the ^{20}Ne(^{3}He,p) angular distributions. The states of ^{22}Na are discussed in terms of Nilsson states and associated rotational bands. (Diss. Abstr. Int., B)

1216 ANGULAR CORRELATION OF 1.118-MeV γ-QUANTA RESONANCE-SCATTERED BY ^{65}Cu NUCLEI. Shubnyi, Yu. K.; Lysikov, Yu. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz. Mat.; No. 6, 7-11(Nov-Dec 1970). (In Russian).

By using Coulomb fragmentation of $ZnBr_2$ molecules during K capture by ^{65}Zn, the dependency of the cross section for resonance scattering upon the scattering angle was investigated. From this the angular correlation coefficients were computed by the method of least squares. E2–M1 multipole mixing coefficients were obtained. A satisfactory comparison was made of the data obtained with the inferences from the Lawson–Uretsky model of the nucleus. The good agreement of the data with the vibrational model of the nucleus is pointed out. (tr-auth)

1217 IONIZATION EFFECTS DURING K CAPTURE IN ^{65}Zn. Kaipov, D. K.; Lysikov, Yu. A.; Shubnyi, Yu. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 11-14(Nov-Dec 1970). (In Russian).

Ionization effects in molecular systems during K capture and subsequent Auger transitions were investigated by means of nuclear resonance scattering of γ radiation with energy of 1.118 MeV by ^{65}Cu nuclei. The cross section of resonance scattering was measured for three ^{65}Zn compounds: $ZnCl_2$, $ZnBr_2$, and ZnI_2. Energy compensation, lost on recoil, is achieved on account of (at the expense of) Coulomb fragmentation of charged molecular ions, arising during Auger transitions, following K capture in ^{65}Zn. The relation between the cross section of resonance scattering and atomic number of the halogen in the compound is under study. (tr-auth)

1218 (n,p) CROSS SECTIONS OF ^{46}Ti, ^{47}Ti, ^{48}Ti, AND ^{90}Zr AT NEUTRON ENERGIES BETWEEN 3.4 AND 6.1 MeV. Ghorai, Susanta Kumar. Auburn, Ala.; Auburn Univ. (1971). 89p. University Microfilms Order No. 71-20,209.

Thesis.

Activation techniques were used to measure the ^{46}Ti(n,p)^{46}Sc reaction cross sections at neutron energies of 4.1, 5.0, and 6.1 MeV; ^{47}Ti(n,p)^{47}Sc reaction cross sections at neutron energies of 3.4, 4.1, 5.0, and 6.1 MeV; and ^{48}Ti(n,p)^{48}Sc reaction cross sections at neutron energies of 5.0 and 6.1 MeV. Also, the ^{90}Zr(n,p)^{90m}Y reaction cross section was measured at 6.1 MeV. The D(d,n)^{3}He reaction was used to produce neutrons, and the ^{27}Al(n,p)^{27}Mg reaction was used for monitoring neutrons. A 20 cm^3 Ge(Li) detector was utilized to detect the gamma rays. Corrections were made for the self-absorption and coincidence-summing effects. A comparison is made of the observed cross sections of ^{47}Ti(n,p)^{47}Sc and ^{46}Ti(n,p)^{46}Sc reactions with a theoretical estimate based on the Hauser–Feshbach statistical

theory of nuclear reactions with the assumptions that only the ground states and possibly the first excited states of the residual nuclei contributed to the cross sections. (Diss. Abstr. Int., B)

1219 HIGH RESOLUTION STUDY OF ISOBARIC ANALOG RESONANCES IN ^{51}Mn, ^{53}Mn, AND ^{55}Mn. Moses, John Dawsey. Durham, N. C.; Duke Univ. (1970). 165p. University Microfilms Order No. 71-21,547.

Thesis.

The excitation functions for elastic scattering by the even chromium isotopes were measured at laboratory energies ranging from 1.8 MeV to 3.3 MeV. In addition, the ^{50}Cr(p,p$_1$)^{50}Cr* excitation function was measured from $E_p \simeq 2.3$ MeV to $E_p \simeq 3.3$ MeV, and the ^{54}Cr(p,n)^{54}Mn total cross section was measured from the threshold ($\simeq$2.20 MeV) to $E_p \simeq 2.90$ MeV. For all of these data, the energy resolution was 300 to 400 eV. The fine structure resonances were analyzed in terms of parameters of the R-matrix theory. The analogs of the 2.324- and 2.676-MeV states of ^{53}Cr were observed in ^{53}Mn. The analogs of the ground state, the 245-keV state, and the 573-keV state of ^{55}Cr were observed in ^{55}Mn. The three IAR in ^{55}Mn and analog of the 2.324-MeV state in ^{53}Mn are highly fragmented into fine structure resonances. At least six analog states are seen in ^{51}Mn, but their identification is often ambiguous due to the background of large, widely spaced T< resonances. The analog of the 4.070-MeV state of ^{51}Cr is highly fragmented. The fine structure of most of the highly fragmented IAR follows the expected asymmetric distribution. The fine structure of the ground state analog in ^{55}Mn does not, probably because of statistical fluctuations. The parent state spectroscopic factors are calculated from the fine structure data, and compared with (d,p) spectroscopic factors. In most cases the analog state spectroscopic factors are somewhat smaller than the (d,p) results. The fine structure of the analog of the third excited state of ^{55}Cr was examined for evidence of enhancement in the neutron channel. There is no evidence that the neutron channel is enhanced. Proton strength functions are calculated from the T< resonance parameters. The strength functions fluctuate around the black nucleus value. (Diss. Abstr. Int., B)

1220 FINE STRUCTURE OF ANALOG STATES IN ^{56}Co, ^{57}Co, AND ^{59}Co. Lindstrom, Daniel Peter. Durham, N. C.; Duke Univ. (1970). 104p. University Microfilms Order No. 71-21,543.

Thesis.

Differential cross sections for ^{54}Fe(p,p), ^{56}Fe(p,p), and ^{58}Fe(p,p) were measured at laboratory angles of 160°, 135°, 120°, and 90° for proton energies of between 1.8 and 3.3 MeV. Thin targets of enriched isotopes were used, and the observed energy resolution was 300 to 400 eV. Analogs of four excited states of ^{55}Fe were identified in the ^{54}Fe(p,p) experiment. The analog of the seventh excited state of ^{57}Fe was identified; and two higher excited states tentatively identified in the ^{56}Fe(p,p) experiment. The analogs of the ground state and first excited state of ^{59}Fe were observed in the ^{58}Fe(p,p) experiment. Only the latter two analogs were significantly fragmented, the other analogs appearing as one or two levels. Analysis of the data using single-level or multi-level R-matrix codes yielded resonance parameters, which were used to calculate spectroscopic factors for each analog. The single-particle widths used in extracting spectroscopic factors were calculated by three different methods. Comparison with spectroscopic factors from (d,p) experiments reveals discrepancies in some cases and agreement in others. Coulomb energy differences between the analogs and their parent states were extracted; the results were consistent with those of other experiments. Resonances not associated with analog states yielded information about proton strength functions and level spacings. For a given spin and parity, considerable variation of strength functions was noted between the three isotopes investigated. (Diss. Abstr. Int., B)

1221 REACTION ^{87}Rb(d,p)^{88}Rb FOR DEUTERON ENERGIES OF 4 TO 6 MeV. Torti, Richard Philip. University Park, Pa.; Pennsylvania State Univ. (1970). 75p. University Microfilms Order No. 71-21,812.

Thesis.

The reaction ^{87}Rb(d,p)^{88}Rb was studied with 4- to 6-MeV deuterons. Targets 30 μg/cm^2 thick were fabricated by evaporation of isotopically enriched $^{87}Rb_2CO_3$ on to thin carbon backings. Protons were collected in a 1.5-mm-thick silicon surface-barrier detector. A thinner silicon detector was used as a beam monitor. Proton angular distributions were taken from 60° to 160° at 4, 5 and 6 MeV bombarding energies. Excitation functions were measured in 0.25-MeV steps from 4 to 6 MeV at 145°. Elastic deuteron cross sections were observed at 4, 5, and 6 MeV. Four sets of deuteron optical-model parameters were adjusted to generate elastic cross sections that fit the data at 6 MeV. The stripping cross sections, which were calculated by the distorted-wave Born approximation codes RDRC and DWUCK, were found to be similar in shape but varied by ±15% in amplitude depending upon the choice of deuteron parameters. Spectroscopic factors obtained with any one set of parameters never deviated more than the experimental uncertainty of 15% with bombarding energy. Calculated cross sections were very sensitive to the radius parameter of the neutron potential well. Twenty-four levels up to 3 MeV excitation were populated in ^{88}Rb. Four tentative and ten definite l_n assignments were made on the basis of angular distribution shapes and the 4 to 6 MeV excitation functions. The ground and first three excited states in ^{88}Rb populated by the stripping reaction arise mainly from the coupling of the $p_{\frac{1}{2}}$ proton hole to the 51st neutron in the $2d_{\frac{5}{2}}$ shell-model orbital. The higher excited states apparently have significant components of configurations not populated in the stripping reaction and, therefore, could not be interpreted simply. (Diss. Abstr. Int., B)

1222 DIFFERENTIAL RANGE STUDIES OF THE (α,αn) AND (^{3}He,α) REACTIONS OF ^{65}Cu. Chang, Shi-kuang. Lafayette, Ind.; Purdue Univ. (1971). 119p. University Microfilms Order No. 71-20,438.

Thesis.

The differential ranges of the recoil product from the ^{65}Cu (α,αn) reaction were measured over the energy interval of 24 to 43 MeV by means of the electrostatic collection technique. The results are compared with a Monte Carlo calculation based on the statistical theory. The differential ranges obtained at the lower energies are found to be in satisfactory agreement with a compound-nucleus process. The ranges at higher energies are smaller than the calculated values; this result indicates that a direct interaction is of importance above 35 MeV. Differential ranges of angularly selected ^{64}Cu recoils from the ^{65}Cu (^{3}He,α) reaction at 32 MeV were measured. Comparison with calculations indicates that the recoils emitted at 0° to 12° to the beam arise from the evaporation of four single nucleons from a compound nucleus. The differential range obtained at 35° to 46° indicates a contribution from this mechanism as well as from a pick-up process. A computer program was written to calculate the spectra of particles evaporated from a compound nucleus. The program is based upon the spin-dependent statistical theory of nuclear reactions and includes the effect of competitive gamma-ray emission. (Diss. Abstr. Int., B)

1223 DE-EXCITATION OF COMPOUND NUCLEI BY GAMMA-RAY EMISSION IN COMPETITION WITH NUCLEON EMISSION. Hoffman, Edward Joseph. St. Louis; Washington Univ. (1971). 333p. University Microfilms Order No. 71-19,818.

Thesis.

The relative yields to many levels in ^{61}Cu and ^{60}Ni populated via the ^{58}Ni(α,px) reaction were measured at 15, 18, 20, and 22 MeV. The yields to many of these levels were determined as a function of the energy of the protons emitted in coincidence with the γ rays. The results of these measurements were compared to the predictions of the compound statistical model. Level energies, spin assignments, and γ-ray branching ratios of many levels in the product nuclei were determined in a study of the β^+ decay of ^{62}Zn, ^{61}Zn, and ^{60}Cu. Level positions, γ-ray branching ratios, and the γ-ray decay scheme of the levels in ^{61}Cu were determined. Singles spectra of γ rays from the ^{58}Ni(α,pγ) reaction were measured. The originating level of each γ ray was determined, as were the branching ratios of the reaction γ rays. The spin assignments of many levels in ^{61}Cu were determined from the results of p–γ angular distribution measurements with 12.5-MeV alpha particles. The angular distribution was measured. The level schemes and branching ratios of γ rays determined for ^{61}Cu and ^{60}Ni allowed corrections to be made for γ-ray cascades and unobserved γ rays. The quantities determined in these measurements were independent yields to each observed level as a function of the energy of the emitted protons. The predictions of the statistical model were calculated by utilizing the spin values and level assignments determined. The agreement of the theoretical calculation with the experimental results was excellent. The calculations confirmed the importance of inclusion of γ-ray competition in the theory. Experimentally, the importance of γ-ray competition with proton emission was directly established by the fact that most of the yield to the levels in ^{61}Cu came from excitation energies above the Coulomb barrier. The shape of yield curves and relative populations of individual levels was found to be insensitive to the γ-ray strength. Also, the value of the moment of inertia at low excitation energies was found to be critical for the calculation of the correct independent yield to each level. The ratios of proton and γ-ray emission widths were deduced as a function of ^{61}Cu excitation energy and spin. (TSS)

1224 DECAY SCHEME STUDIES IN THE REGION OF 29 TO 39 NEUTRON NUMBER. Ward, Thomas Edmund. Fayetteville, Ark.; Univ. of Arkansas (1971). 153p. University Microfilms Order No. 71-19,548.

Thesis.

The decay schemes of ^{50}Sc, ^{53}V, ^{54}V, ^{57}Mn, ^{58}Mn, ^{62}Co, ^{63}Co, ^{64}Co, and ^{68}Cu were studied using a Ge(Li) spectrometer and β- and γ-ray scintillation detectors. New isomers of ^{58}Mn (3.0 sec) and ^{68m}Cu (3.8 min) were identified in addition to a new isomer of ^{64}Co (0.4 sec) and a new assignment of ^{63}Co (26 sec). Gamma-ray intensities, β-ray intensities, and $\beta-\gamma$ and $\gamma-\gamma$ coincidence measurements were measured along with the half-lives. Ground-state and isomeric-state spin-parity assignments were deduced, in addition to several assignments of spin-parity to the excited levels in the daughter nuclei. The β-decay Q values for each of the nuclei were also determined. Decay schemes are presented and discussed in terms of the more recent theoretical and experimental studies of the region. (Diss. Abstr. Int., B)

1225 NUCLEAR REACTIONS OF ^{51}V INDUCED BY MEDIUM ENERGY BREMSSTRAHLUNG. Weisfield, Michael William. Troy, N. Y.; Rensselaer Polytechnic Inst. (1971). 116p. University Microfilms Order No. 71-19,897.

Thesis.

Reactions of ^{51}V with bremsstrahlung with energy up to and including 90 MeV were carried out. The product nuclides observed were ^{48}V, ^{48}Sc, ^{47}Sc, ^{46}Sc, ^{44}Sc, ^{43}K, and ^{40}Cl. The yields of these nuclides were compared to those generated by a statistical-model evaporation program. The comparison with theory was made with total yields of a given nucleus integrated over all photon energies, integral yields taken relative to a specific product, and difference yields in which the difference in yield taken in 10-MeV to 15-MeV increments is compared to total integral yield from 45 MeV to 90 MeV. The integral yields show that there is a large increase in yield above 80 MeV, which is not found in the theoretical calculation. This could be explained by a large change in the compound-nucleus-formation or photon-absorption cross section. The relative yield curves allow the study of the integrated absorption cross section. These data indicate that, if the de-excitation is accurately predicted by theory, then the absorption cross section changes at a different rate for each product. The difference yields were computed; they show that the experimental absorption cross sections are changing sharply over a small energy interval. A relative measure of the lifetime or width of the initial state of the excited target nucleons is determined. These widths are found to be in agreement with the trends in yield of the various products. It was concluded that, in addition to a change in the absorption cross section, there were contributions to the yield other than from a statistical equilibrium process. This second process could be related to a precompound mechanism or a reaction mechanism that resembles a direct interaction between the incident photon and nucleons or clusters of nucleons in the target nucleus. (TSS)

1226 (p,nγ) REACTION STUDY OF EXCITED STATES IN ^{58}Cu, ^{54}Co, ^{50}Mn, AND ^{46}V. King, Nicholas S. P. Boulder, Colo.; Univ. of Colorado (1970). 185p. University Microfilms Order No. 71-21,600.

Thesis.

Levels of the odd-odd, N = Z nuclei ^{46}V, ^{50}Mn, ^{54}Co, and ^{58}Cu were studied by means of the (p,nγ) reaction with proton beams from the University of Colorado cyclotron for a range of proton energies from 7 to 16 MeV. To insure positive identification of gamma rays originating from the (p,nγ) reaction, the use of a neutron-gamma ray coincidence circuit was found necessary. An NE224 liquid scintillator served as a neutron detector, and a 25-cm^3 Ge(Li) detector was used for gamma-ray detection. Both singles and coincidence gamma-ray spectra were obtained with the Ge(Li) detector at 90° relative to the proton beam. Additional information on the level structure and relative excited-state populations was obtained from neutron time-of-flight spectra from the (p,n) reaction and from (^{3}He,t) reaction spectra taken in this experiment. These spectra proved to be particularly helpful for ^{46}V and ^{50}Mn, for which very little level structure information was available. Level schemes and a restriction of possible spins based on the gamma-ray data are given up to an excitation energy of 2 MeV for each nucleus. Also, new levels were observed in ^{46}V, ^{50}Mn, and ^{58}Cu. (Diss. Abstr. Int., B)

1227 USE OF THE WOODS-SAXON POTENTIAL WITH THE VOLUME ABSORPTION FOR THE α-PARTICLE ELASTIC SCATTERING. Simonov, I. N.; Terenetskii, K. O.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 14: No. 1, 104-8(Jul 1971). (In Russian).

The possibility is analyzed of describing the 27.2 MeV α-particle elastic scattering by ^{50}Cr, ^{56}Fe, ^{58,60}Ni, ^{64,66,70}Zn nuclei using the 4-parameter optical potential. The regions of discrete and continuous ambiguity for the parameters of the model are selected. Eight "unified" and optimal sets of parameters for the series of nuclei considered are obtained. (auth)

1228 EXCITATION OF LOW LYING STATES OF ^{70}Ge AND ^{72}Ge DURING INELASTIC NEUTRON SCATTERING NEAR THRESHOLD. Konobeevskii, E. S.; Musaelyan, R. M.; Popov, V. I.; Surkova, I. V. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 14: No. 1, 14-21(Jul 1971). (In Russian).

Excitation cross sections are investigated for the first levels 2^+ and 0^+ of ^{70}Ge and ^{72}Ge nuclei in inelastic neutron scattering in the energy interval from the threshold up to about 200 keV above the excitation threshold. The experimental data are compared with calculations based on the theory of the average cross sections using the neutron strength functions for the entrance and exit channels as independent parameters. The experimental excitation cross sections for the 2^+ levels and the corresponding strength functions of the s and d neutrons exceed the values expected in view of the optical model with a spherical potential. (auth)

1229 INVESTIGATION OF IRON AND NICKEL ISOTOPE NUCLEI BY MEANS OF ELASTIC ELECTRON SCATTERING. Litvinenko, A. S.; Shevchenko, N. G.; Buki, A. Yu.; (and others) (Physical-Technical Inst., Kazan). Yadern. Fiz.; 14: No. 1, 40-6(Jul 1971). (In Russian).

Elastic cross sections of scattering of electrons with energy of 225 MeV on the isotopes ^{54,56,58}Fe and ^{58,62}Ni are measured. Starting from the two-parameter Fermi model the dependences of the charge density distribution radii, $r_{0.5}$, the depth of the surface layer, t, and r.m.s. radii, $\langle r^2\rangle^{1/2}$, on the mass number were determined. The results of the experiment are compared with the available data on the electron and proton scattering and the muon capture. (auth)

1230 EXPERIMENTAL DETERMINATION OF THE NORMALIZATION FACTORS FOR (α,τ) AND (α,t) REACTIONS. Hauser, G. (Univ., Heidelberg); Loehken, R.; Nowicki, G.; (and others). Lett. Nuovo Cim.; 2: No. 8, 405-8(21 Aug 1971).

The reactions ^{40}Ca(α,^{3}He)^{41}Ca and ^{40}Ca(α,t)^{41}Sc were studied at 104 MeV to obtain experimental normalization factors for DWBA analysis. The differential cross sections and optical potentials found are given. (R.W.R.)

1231 PRECISION MEASUREMENT OF THE β-SPECTRUM SHAPE OF ^{32}P. Zemann, H.; Semrad, D.; Paul, H. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). Nucl. Phys.; A175: No. 2, 385-95(1971).

The spectrum shape of ^{32}P was carefully remeasured in a magnetic intermediate-image spectrometer. Sources were produced in a mass separator to improve source quality and to remove ^{33}P. The possible disturbing influences of a nonideal magnetic field and of scattering in the various baffles, in the source, and in the source holder were measured, and upper limits were placed on the various effects. An improved source holder that gives very little scattering and an improved scintillation detector with background cancellation were used. Small corrections for finite resolution and for backscattering from the scintillator and from the source foil were applied. In contradiction to many published results, a shape factor coefficient $a = (0.01^{+0.25}_{-0.81}) \times 10^{-2}$ $(mc^2)^{-1}$, i.e., a statistical spectrum shape, was obtained. The main contribution to the error comes from the estimates of possible but undetected disturbing effects. The end-point energy is 1711 ± 2 keV. (auth)

1232 LEVELS IN ^{35}Cl: EXPERIMENTAL. Wiesehahn, W. J. (Univ. of Toronto). Can. J. Phys.; 49: No. 19, 2396-2414(1 Oct 1971).

Decay schemes, angular distributions, and polarizations of gamma rays from the reaction ^{34}S(p,γ)^{35}Cl were measured. The lifetimes of some of the levels which were populated in these reactions were measured. The four resonances excited by protons of 1020, 1214, 1267, and 1510 keV were studied. Spin and parity assignments for the 1220-, 1762-, 2645-, 2695-, 3006-, 3163-, 4058-, 4174-, 7355-, 7545-, 7601-, and 7845-keV energy levels and the lifetimes of the first six of these are discussed. (auth) (Canada)

1233 LEVELS IN ^{35}Cl: THEORETICAL. Wiesehahn, W. J. (Univ. of Toronto). Can. J. Phys.; 49: No. 19, 2415-24(1 Oct 1971).

The experimental results obtained for ^{35}Cl are interpreted in terms of the shell model with core excitations. The states at 3165 and 7545 keV are $f_{1/2}$ states. The states at 4174 and 7841 keV are $p_{3/2}$ states. In both cases the higher-energy state is the isobaric analogue of a state in ^{35}S. All other states below 6 MeV may possibly be described as an excited core to which is coupled

a $d_{3/2}$ proton. This particularly explains the extreme retardation of the transition between the 3164-and 2645-keV states. (auth) (Canada)

1234 INTERACTION OF FAST NEUTRONS WITH ORIENTED ^{59}Co NUCLEI. Healey, Dennis Charles. Stanford, Calif.; Stanford Univ. (1971). 147p. University Microfilms Order No. 71-19,697.

Thesis.

The interaction of polarized and unpolarized neutrons with oriented ^{59}Co nuclei was investigated. A half-mole sample of polycrystalline cobalt metal was cooled by a ^{3}He–^{4}He dilution refrigerator to 0.040 ± 0.004°K and magnetized to M/M_s = 0.93 parallel to the neutron beam. The first two statistical tensors describing the nuclear orientation were $B_1 = (0.334 \pm 0.026)B_{1(max)}$ and $B_2 = (0.065 \pm 0.012)B_{2(max)}$. The "spin–spin effect" was measured over a continuous range of neutron energies from 0.3 MeV to 1.6 MeV and at 3.35 MeV and 7.75 MeV. Below an energy of 1 MeV, the spin–spin cross section shows strong fluctuations. These fluctuations also appear in the total cross section, and result from fluctuations in the level spacings and widths in the ^{60}Co compound nucleus. Efforts to explain the average spin–spin effect were attempted. In general these attempts were unsuccessful in that they predicted spin–spin potentials that are repulsive for spin-parallel nucleons and that have magnitudes of the order of 10% of the real part of the optical potential. The "deformation effect" was measured for unpolarized neutrons at several neutron energies in the range from 0.3 MeV to 1.6 MeV. The average effect is consistent with the totally absorbing black-body model of the nucleus for a nuclear deformation of $\beta = 0.18$. (TSS)

1235 ELECTRON SCATTERING TESTS OF NUCLEAR MODELS. Peterson, R. J. (Yale Univ., New Haven). Ann. Phys. (N. Y.); 65: No. 1-2, 125-40(15 Jun 1971).

Microscopic nuclear models that have proven adequate for the understanding of transitions in ^{40}Ca, ^{51}V, and ^{52}Cr are used to generate elastic and inelastic electron scattering cross sections. The comparison to the data shows, for the collective octupole transition in ^{40}Ca and for the elastic and quadrupole inelastic scattering from ^{52}Cr, that the models provide too compact a charge or transition charge distribution. The microscopic model for ^{51}V, however, provides predictions in excellent agreement with the observations. (auth)

1236 VARIATION OF THE DEFORMATION PARAMETER ON THE FERMI MATRIX ELEMENT OF A DEFORMED DOUBLY ODD NUCLEUS. Tee, C. S.; Yap, C. T. (Univ. of Singapore). Nucl. Phys.; A174: No. 1, 221-4(1971).

Contributions to the Fermi matrix elements for the $\Delta T = -1$ β^- transition of ^{24}Na from the Coulomb potential and charge asymmetry of nuclear forces are calculated for different values of the deformation parameter. It is shown that the theoretical estimates are insensitive to the magnitude of deformation adopted. (auth)

1237 REACTION MECHANISMS AND SHELL STRUCTURE EFFECTS IN ^{54}Fe + ^{6}Li AND ^{58}Ni + d REACTIONS AT MEDIUM ENERGIES. Cline, C. K. (Univ. of Rochester, N. Y.). Nucl. Phys.; A174: No. 1, 73-96(1971).

Excitation functions and average recoil ranges for products formed in deuteron induced reactions on ^{58}Ni and in ^{6}Li ion induced reactions on ^{54}Fe have been measured. The incident energies considered ranged from 4 to 40 MeV for the deuterons and from 15 to 60 MeV for the ^{6}Li ions. The recoil range values indicate the predominance of equilibrium compound nucleus processes at energies up to and several MeV beyond the peaks in the excitation functions. At still higher energies a statistical model analysis of the data indicates the increasing importance of preequilibrium particle emission. In the analysis, the consideration of shell effects according to Rosenzweig's model leads to greatly improved estimates of the experimental isobaric yield ratios. Evidence for direct reaction processes leading to the formation of ^{57}Ni and ^{56}Ni in the deuteron induced reactions and to ^{55}Co in the lithium ion induced reactions has also been observed. The validity of the independence hypothesis is verified for excitation energies at which the recoil ranges indicate the predominance of equilibrium statistical processes in both reaction systems. (auth)

1238 ENERGY LEVELS OF ^{43}Sc EXCITED BY THE (τ,t) REACTION. Alford, W. P.; Schulz, N.; Jamshidi, A. (Univ. of Rochester, N. Y.). Nucl. Phys.; A174: No. 1, 148-60(1971).

Levels of ^{43}Sc below an excitation energy of 5 MeV have been studied using the ^{43}Ca$(\tau,t)^{43}$Sc reaction. Up to an energy of about 3 MeV, most of the levels populated strongly are those assigned to the $(fp)^3$ configuration. Known even-parity states and most 5p-2h states are very weakly excited. The transition to the isobaric analog of the ^{43}Ca ground state shows a characteristic L = 0 angular distribution. Angular distributions with a backward peaking provide support for suggested assignments for the lowest $^{13}/_2^-$ and $^{15}/_2^-$ $(fp)^3$ states. The identification of the previously unknown $^{13}/_2^-$ and $^{17}/_2^-$ members is also suggested from these results. The wide variety of shapes observed in other transitions indicates that the angular distributions reflect nuclear structure effects as well as the spin change involved. (auth)

1239 EFFECTS OF REORIENTATION IN THE FIRST EXCITED STATES OF ^{46}Ti AND ^{48}Ti. De Castro Faria, N. V.; Charbonneau, J.; L'Ecuyer, J.; Levesque, R. J. A. (Univ. of Montreal). Nucl. Phys.; A174: No. 1, 37-48(1971). (In French).

The first 2^+ states in ^{46,48}Ti were excited using a beam of ^{16}O at energies below the Coulomb barrier. The data were interpreted in terms of the semiclassical theory of the Coulomb excitation and the analysis with a coupled-channel computer code yields the values of the reduced transition probabilities $B(E2; 0_1^+ \rightarrow 2_1^+) = 0.097 \pm 0.007e^2 \cdot b^2$ and $0.072 \pm 0.004e^2 \cdot b^2$, for the ^{46}Ti and ^{48}Ti, respectively. The static quadrupole moments of the first excited states were also extracted from the data and the values obtained are $Q(^{46}\text{Ti}, 0.889\ \text{MeV}) = -0.28 \pm 0.14\ e \cdot b$ and $Q(^{48}\text{Ti}, 0.983\ \text{MeV}) = -0.38 \pm 0.13\ e \cdot b$, neglecting the effects of higher excited states. These results are compared with recent theoretical calculations and with the values obtained by Häusser et al. The agreement with these experimental results is satisfactory. (auth)

1240 STUDY OF LOW LYING STATES OF ^{24}Mg. Manakos, P. (Technische Hochschule, Darmstadt, Ger.). Z. Phys.; 247: No. 2, 127-46(1971).

A systematic method for the choice of configurations has been applied to T = 0 positive parity states of ^{24}Mg. Shell model calculations with central forces have been performed for various truncations of the vector space. (auth)

1241 (α,n) REACTIONS ON NUCLEI WITH INTERMEDIATE ATOMIC NUMBER. Okorokov, V. V.; Serezhin, V. M.; Smotryaev, V. A.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 14: No. 2, 287-91(Aug 1971). (In Russian).

The (α,n) reactions on nuclei ^{27}Al, ^{54,56}Fe, ^{58}Ni were investigated. Angular distributions and differential cross sections are obtained for the neutron groups, resolved by means of the neutron spectrometer. The neutron energy was determined by the time-of-flight method. (auth)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 134, 144, 338, 419, 719, 978, 1154, 1155, 1167, 1168, 1174, 1187, 1202, 1207, 1209, 1361, 1362, 1374, 1400, 1402, 1639, and 1645–1647.

1242 (BARC/I–84) IRRADIATION OF ANTIMONY IN CIRUS. THE REACTOR NEUTRON CAPTURE CROSS SECTIONS OF ^{123}Sb AND ^{124}Sb. Sankaranarayanan, S.; Narain, Rajendra; John, Benjamin (Bhabha Atomic Research Centre, Bombay (India)). 1970. 15p. INIS.

Measured ^{124}Sb activities obtained in irradiations were used in the analysis of the reactor neutron absorption cross sections of antimony isotopes. A computer program SBCURIE developed for this purpose is described. The study indicates that it is reasonable to take a cross section set of $\sigma_{eff}^{123} = 4.5$ barns and $\sigma_a^{124} = 6.5$ barns to predict ^{124}Sb activity for antimony irradiations in CIRUS. (INIS)

1243 (CEA-R-4196) METHOD FOR MEASURING INTERNAL CONVERSION COEFFICIENTS: APPLICATION TO ^{137}Ba. Brethon, Jean-Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1971. 103p. (In French). Rep. NTIS (U. S. Sales Only).

Some methods of measuring internal conversion coefficients are given, together with their advantages and disadvantages. A new method, based on "fast slow" coincidences with X rays and conversion electrons, using Si–Li detectors, is presented. The development of the spectrometer device and its application to α_K measurements with ^{113}In (α_K = 0.446 ± 0.012) and ^{137}Ba (α_K = 0.0901 ± 0.0010) are described. (France)

1244 (CONF-690217–, pp 250-72) TERNARY FISSION. Pik-Pichak, G. A. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

The term "ternary fission" designates the simultaneous generation of 3 charged particles during the fission process. They may consist of 2 fragments with a mass of about 100 and a light charged particle, such as ^{2}H, ^{3}H, ^{6}He, ^{8}He, ^{7}Li, etc, or of 3 fragments with nearly identical mass. The probability of occurrence of these fissions is low and the terminology used in the studies has not yet been standardized. The ternary fission of ^{235}U has been first investigated experimentally in 1947 by means of photographic emulsions containing ^{235}U. The resulting triple stars have been attributed later to the scattering of fission fragments on the Ag and Br nuclei of the emulsion. The total kinetic energy of the triple fission fragments, 142 MeV, is 24 MeV lower than that of the fragments in the usual fission. The mass yields determined by radiochemical methods indicated parasitic effects rather than triple fission. Creation of 3 fission fragments has been definitely established in fission processes due to multiply charged ions. Glass and mica track detectors have been used to determine ternary fission events; irradiation of Pb and U with 414-MeV ^{40}Ar ternary fission was found to occur for each 200 double fission of Pb and each 300 such fission of U. Fission under emission of light charged particles, such as α particles, has been more extensively studied than ternary fission. No correlation has been established between the probability of emission of n, $\bar{n}$, ^{2}H, ^{3}H, ^{3}He, ^{4}He, ^{6}Li, ^{8}Be and the required energy (Review article, 29 references). (TTT)

1245 (CONF-710301-(Vol.1), pp 127-32) CROSS SECTION EVALUATIONS BY INTEGRAL MEASUREMENTS. **Orestano, F. V.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A number of cross section sets of interest for spectral index measurements in thermal spectra have been evaluated by integral methods by irradiating samples in different known spectra. In particular new data have been obtained for the reactions $^{151}Eu(n,\gamma)^{152m}Eu$(9.2 h) and $^{175}Lu(n,\gamma)^{176}Lu$. (auth)

1246 (CONF-710301-(Vol.1), pp 133-9) FISSION PRODUCT CROSS SECTION FOR THE THERMAL REACTOR. **Sakata, H.; Nagayama, S.; Otake, I.; Matsunobu, H.; Iijima, S.; Saito, K.; Kobayashi, T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Concerning the burn-up analysis in the thermal reactor, the multi-group constants of FP's have been studied on the following items. (1) The data of thermal neutron cross sections, resonance parameters and decay constants are collected from BNL-325 and other literatures. A set of 30 and 54 groups for thermal and fast regions is compiled after above data are evaluated. The resonance integrals are also obtained with cut-off energy at 0.5 eV. Fission yields have been adopted for the values of Rider, et al., (1967). (2) The build-up amounts of FP's have been calculated for the flux levels of 10^{12}, 10^{13}, and 10^{14} n/cm^2 sec. From these results, the important FP's are determined and each nuclide is classified into 3 groups except ^{105}Rh, ^{113}Cd, ^{135}Xe, ^{149}Sm, ^{151}Sm, ^{155}Eu, ^{155}Gd and ^{157}Gd. (3) Based on the results described in (1) and (2), a library has been made as a function of the flux level and the irradiation time. (auth)

1247 (CONF-710301-(Vol.1), pp 241-7) NEUTRON INELASTIC SCATTERING FROM ^{91}Zr. **Glickstein, S. S.; Tessler, G. (Bettis Atomic Power Lab., West Mifflin, Pa.).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Gamma ray production cross sections produced via the $^{91}Zr(n,n'\gamma)$ reaction have been measured up to 2.37 MeV neutron energy at an angle of 55° to the incident neutron beam. Neutrons were produced from a solid tritium target (~75 keV thick) using the 3 MeV Bettis Van de Graaff accelerator. The gamma rays observed at energies of 1204.7, 1466.4, 1882.2, 2042.5, 2131.4, 2169.7, 2190.1 and 2200.7 keV were detected with a 55 cc Ge(Li) detector (3 keV resolution) placed inside a NaI annulus to suppress Compton events. The energies are in excellent agreement with previously reported work. The data have been corrected for multiple scattering and neutron flux attenuation in the sample. Angular distributions have been calculated and used to obtain the total gamma ray production cross section. The data are in good agreement with the results of Hauser–Feshbach calculations corrected for width fluctuations. (auth)

1248 (CONF-710301-(Vol. 1), pp 248-51) STUDIES OF LOW ENERGY GAMMA RAYS PRODUCED BY (n,xγ) REACTIONS. **Grenier, G. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The experimental technique is compared with previous measurements of Tucker et al. A brief description of a spectrometer which permits one to analyze the low energy gamma rays ($E_\gamma > 30$ keV) in the presence of a strong high energy photon background is given. The main features of this device are indicated. The first measurements made with this spectrometer are presented: fluorescence X rays and low energy gamma rays produced by interaction of 14 MeV neutrons in tungsten and gold samples. (auth)

1249 (CONF-710301-(Vol.1), pp 252-8) RADIATIVE CAPTURE CROSS SECTIONS FOR 1-1000 keV NEUTRONS. **Fricke, M. P.; Mathews, D. R.; Friesenhahn, S. J.; Carlson, A. D.; Neill, J. M. (Gulf Radiation Technology, San Diego, Calif.).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Absolute average capture cross sections have been measured for Mo, Rh, Gd, Ta, W, Re, Au and ^{238}U over a continuous neutron energy range ~1–1000 keV. These data and their nuclear-model representations are discussed, and calculations for fast critical reactors are presented which were made using the present results for capture by ^{238}U. (auth)

1250 (CONF-710301-(Vol.1), pp 259-65) NEUTRON CAPTURE CROSS SECTIONS IN THE MeV RANGE. **Nagle, R. J.; Landrum, J. H.; Lindner, M. (California Univ., Livermore. Lawrence Radiation Lab.).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Neutron capture cross sections have been measured for the nuclides ^{238}U, ^{237}Np, ^{232}Th, ^{197}Au, ^{193}Ir, ^{191}Ir, ^{187}Re, ^{185}Re, ^{186}W, ^{181}Ta, and ^{114}Cd from about 100 keV to about 3 MeV. Neutrons were produced by the $T(p,n)^{3}He$ reaction on tritium gas targets in the Los Alamos low energy van de Graaff accelerator or titantium tritide targets in the Livermore 2-MeV van de Graaff accelerator. Metallic sample foils were arrayed at fixed angles from 10 to 150 deg and at fixed distances of 10 to 20 cm from the source, in order to achieve a multiplicity of neutron exposure energies. Samples were also exposed at a distance of 2 m to serve as a measure of background activation for each foil. The neutron flux was measured at only one angle, usually in the forward direction, and fluxes at the sample exposure angles were calculated from the ratios of the intensities known from angular distribution data. Agreement of the gold results with other recent work lends confidence that the discrepancies which existed between the activation and liquid scintillator methods have been largely eliminated. (auth)

1251 (CONF-710301-(Vol. 1), pp 273-9) MEASUREMENT OF THE CAPTURE-TO-FISSION RATIO α FOR ^{235}U AND ^{239}Pu WITH A NEW TECHNIQUE. **Bandl, R.-E.; Miessner, H.; Froehner, F. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The shape of α, the ratio of capture to fission cross section, has been measured for ^{235}U and ^{239}Pu in the neutron energy range from 8 to 60 keV. A pulsed neutron beam from a ^{7}Li Van de Graaff source was used. The absorption was found by a comparison of the scattered neutrons from the fissile sample with those from a non-absorbing lead sample. The fast fission neutrons were simultaneously detected with an organic liquid scintillator. (auth)

1252 (CONF-710301-(Vol.1), pp 280-5) FACILITY FOR THE MEASUREMENT OF FAST NEUTRON FISSION CROSS SECTIONS USING AN INTENSE CYCLOTRON NEUTRON SOURCE. **Cierjacks, S.; Kopsch, D.; Nebe, J.; Schmalz, G.; Voss, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik).**

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A facility for the study of fission ratios and fission cross sections in the energy range between 0.5 and 30 MeV is described. For the production of a pulsed neutron beam with a continuous energy spectrum the Karlsruhe isochronous cyclotron is used. The fission fragments are detected by a gas scintillation counter arrangement consisting of nine fission detectors in series. For data acquisition a CDC-3100 on-line computer is used. The principal features and operating characteristics of the facility are described and first results of a measurement on ^{238}U are given. (auth)

1253 (CONF-710301-(Vol.1), pp 286-91) STUDY OF FISSION NEUTRON SPECTRA BY MEANS OF FAST FISSION CHAM-

BER WITH AN ON-LINE COMPUTER. Bertin, A.; Clayeux, G. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The energy spectrum in the range 200 keV–12 MeV of the neutrons emitted in the fission of ^{238}U by 14 MeV incident neutrons has been measured with a time of flight technique in conjunction with a multi-plate fission chamber giving high performances. This chamber permits one to distinguish fission neutrons from those associated with other interactions of the primary 14 MeV neutrons: (n,n'), (n,2n) and (n,3n). The neutron detector with neutron and gamma-ray discriminator of large range is placed at one meter of the chamber. The spectra obtained are interpreted, including the neutrons emitted by the fragments (n,f), and the neutrons evaporated before fission (n,n'f), (n,2nf). The spectrum of fission neutrons in mb/sr x MeV at 90° was determined. The values obtained are compared with previous results. (auth)

1254 (CONF-710301–(Vol.1), pp 292-8) NEUTRON-INDUCED FISSION CROSS SECTIONS OF ^{230}Th AND ^{231}Pa. Muir, D. W.; Veeser, L. R. (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The neutron-induced fission cross sections of ^{230}Th and ^{231}Pa were measured at a resolution of 0.6 nsec/m using a nuclear detonation as a pulsed neutron source. Because of the significant amount of ^{232}Th in our ^{230}Th target, the cross section of ^{232}Th also was measured under the same conditions, in order to facilitate the subtraction from the ^{230}Th data. Information was obtained over an energy range of 0.1–3.0 MeV. The fragments were detected at angles of 100 and 165° and angle-integrated cross sections derived from published angular distributions. Above threshold, the uncertainty in the derived cross sections is about 15%. A subthreshold resonance was observed in ^{231}Pa at an energy of 158 ± 2 keV. The subthreshold resonance in ^{230}Th at 715 keV was observed to have a width (fwhm) of 32 ± 2 keV. (auth)

1255 (CONF-710301–(Vol.1), pp 306-10) NEUTRON–NEUTRON COINCIDENCE SPECTRA FROM THE Pb(n,2n) REACTION AT 14 MeV. Voignier, J. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A "complete" experiment of the Pb(n,2n) reaction has been performed using a double time of flight spectrometer. The neutron incident energy was 14 MeV. Coincidence energy spectra of the two emerging neutrons have been measured at various angles in the energy range 150 keV–7 MeV. A maximum in neutron spectra is observed at 650 keV. Angular correlation measurements between the outgoing neutrons from the Pb(n,2n) reaction were investigated. The corresponding angular distributions have a strong anisotropy, and a correlation exceeding the error limits can be observed between the directions of neutrons. Doubly differential cross sections have been evaluated. (auth)

1256 (CONF-710301–(Vol.1), pp 393-409) IAEA ACTIVITIES IN REVIEWS OF NUCLEAR DATA: ^{239}Pu FISSION AND ^{238}U CAPTURE IN THE FAST NEUTRON ENERGY REGION. Byer, T. A.; Kon'shin, V. A. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A simultaneous evaluation of all available measurements on the ^{239}Pu fission cross section from 30 keV to 10 MeV, the fission ratio, σ_f $^{239}Pu/\sigma_f$ ^{235}U, from 1 keV to 10 MeV, as well as the ^{238}U capture cross section from 1 keV to 10 MeV has been performed. The measurements in which the fission ratio was directly determined have been treated "separately" from the direct measurements of σ_f ^{239}Pu. A weighted least-squares orthogonal polynomial fitting procedure with a statistical analysis of the fitted curve was used to obtain a "best fit" to the data. (auth)

1257 (CONF-710301–(Vol.1), pp 410-17) RESONANCE PARAMETERS OF ^{235}U UP TO 50 eV. Krebs, J.; Le Coq, G.; L'Heriteau, J. P.; Ribon, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

In order to determine the resonance parameters, various experiments of capture, fission, and total neutron cross sections for ^{235}U were analyzed up to 50 eV by a least square shape analysis program, taking into account interferences in an approximate way and coupled with a display unit. Resonance parameters were determined from those experimental cross sections which appear exempt from significant errors. A value of the average fission width equal to 150 MeV was obtained, i.e., greater than the usually accepted one. (auth)

1258 (CONF-710301–(Vol.1), pp 418-29) ANALYSIS OF THE ^{239}Pu NEUTRON CROSS SECTIONS. Prince, A.; Drake, M. K. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A systematic study has been made of the total and partial neutron cross sections for ^{239}Pu in the energy range from 20 keV to several MeV. The analysis was based on experimentally measured total neutron cross sections including experimentally measured angular distribution data. An extensive series of nuclear model calculations were made and compared with available experimental data. Results from deformed nucleus calculations were combined in a consistent manner with compound nucleus calculations to obtain estimates of all partial neutron cross sections, including fission and radiative capture. In the case of ^{239}Pu, direct inelastic excitation processes (due to the coupling of the first several rotational levels in the ground state) were found to be extremely important in interpreting the available experimental data. (auth)

1259 (CONF-710301-(Vol. 1), pp 430-7) "BEST-FIT" $^{197}Au(n,\gamma)^{198}Au$ CROSS SECTION FOR NEUTRON ENERGIES FROM 10 TO 5400 keV. Vaughn, F. J.; Grench, H. A. (Lockheed Missiles and Space Co., Palo Alto, Calif. Lockheed Palo Alto Research Lab.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A "best-fit" cross section vs. energy curve for the $^{197}Au(n,\gamma)^{198}Au$ reaction has been obtained, based primarily on sets of data which cover a significant range of neutron energies. The "best-fit" curve was first obtained in the 123–560 keV region, where the cross section has a simple shape and where good data are available using several different techniques. The shape and magnitude of the cross section in this region were obtained from least-squares computer fits to the data, assuming that the results of measurements using each of five methods should have equal weight. The curve was then extended upward and downward in energy by considering other data sets and obtaining least-squares computer fits to suitable analytic functions. The cross section curve thus obtained was then compared with the results of experiments in which the cross section was measured at only one or a few energies. Since the agreement was good, no adjustments to obtain a better fit to these additional results were considered necessary. (auth)

1260 (CONF-710301–(Vol.1), pp 438-45) ON THE ORIGIN OF DISCREPANCIES BETWEEN VARIOUS NEUTRON WIDTH DATA SETS FOR ^{232}Th AND ^{238}U. L'Heriteau, J. P.; Ribon, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The existence of systematic discrepancies between the various neutron width data sets for fertile nuclei has recently been emphasized. But it is impossible to know to which extent they are due to experimental disagreement or due to differences in the methods of analysis. To give a partial answer to this question the average values were compared with some individual ones. Also, with the help of the Saclay least square shape analysis code some of the ^{232}Th transmission data obtained in 1963–64 at Columbia University was analyzed. It was possible to improve the agreement by accepting some background and normalization corrections. (auth)

1261 (CONF-710301–(Vol.1), pp 446-55) EVALUATION OF ^{99}Tc AND ^{103}Rh NEUTRON CROSS SECTION FOR ENDF/B. Livolsi, A. Z. (Babcock and Wilcox Co., Lynchburg, Va.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The neutron cross sections of ^{99}Tc and ^{103}Rh have been analyzed using Breit–Wigner single level and Optical Model formalisms from 10^{-5} to 1.5×10^{7} eV for inclusion in the ENDF/B. (auth)

1262 (CONF-710301–(Vol.1), pp 461-8) EVALUATION OF MODIFICATIONS TO ENDF/B VERSION II DATA. Pitterle, T. A.; Paik, N. C.; Durston, C. (Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Reactors Div.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The ENDF/B Version II data file is based on experimental data available up to about September, 1969. This paper describes evaluation efforts toward modifying the Version II data for selected cross sections and isotopes of principal interest to LMFBR analyses with the following twofold objective: to update the data based

on measurements available during 1970 and to evaluate the data within existing experimental uncertainties in order to improve agreement between calculation and integral measurements on critical assemblies. The principal modifications to Version II data include: fission cross sections for ^{235}U, ^{238}U, and ^{239}Pu; capture cross sections for ^{238}U, ^{239}Pu, Fe, Ni and Na; and the total and inelastic scattering cross sections for ^{238}U and Na. Modifications to ^{238}U and ^{239}Pu cross sections are the most important with respect to improving agreement with integral experiments. (auth)

1263 (CONF-710301–(Vol.2)) PROCEEDINGS OF THE THIRD CONFERENCE ON NEUTRON CROSS SECTIONS AND TECHNOLOGY, MARCH 15–17, 1971 AT UNIVERSITY OF TENNESSEE. (Oak Ridge National Lab., Tenn.). Aug 1971. 442p. Dep. NTIS.

Separate abstracts were prepared for 47 of the 55 papers included. The remaining 8 papers have previously had abstracts in NSA. (J.W.R.)

For abstracts of individual papers see: 569, 889, 995, 1138–1140, 1154, 1155, 1169, 1170, 1210–1213, 1264–1295, and 1365.

1264 (CONF-710301–(Vol.2), pp 494-501) HEAVY ACTINIDE CROSS SECTION STORY. Hennelly, E. J. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Improvement in thermal and resonance cross sections for transplutonium nuclides was made by combining limited individual measurements with data obtained from long term irradiations of plutonium at high flux. By requiring consistency in the interpretation of the irradiation data, reasonable limits on absorption and fission cross sections in the chain leading to californium and einsteinium were established. Further improvements are planned as part of a continuing cooperative effort among several AEC laboratories. New information must satisfy the requirement for consistency among the experimental results and the theoretical analyses. (auth)

1265 (CONF-710301–(Vol.2), pp 560-5) SYSTEMATIC UNCERTAINTIES IN THE THERMAL FISSION PARAMETERS. De Volpi, A. (Argonne National Lab., Ill.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A review has been performed on the status of 2200 m/s fission constants, mainly for ^{235}U, ^{239}Pu, and ^{233}U. The most recent evaluation was by the IAEA published in 1969; cross sections and ν and η were accredited with standard errors of about 0.3%. Depending on some partially-subjective views towards experimental credibility, a significantly different set of parameters can be developed. The points of departure are in acceptance by the reviewer of the more recent low measurements of the ^{233}U and ^{234}U half-lives and of reduced downweighting of $\nu(^{252}Cf)$ measurements which have been the object of extensive verification procedures. This leads to 1% lower ν values for the fissile isotopes. In addition, some reductions in η values are experimentally justified. The half-life revisions augment evidence that σ_f for ^{233}U and ^{235}U should be 1% higher than the IAEA average. An adjusted set of fission parameters has been generated with substantive support from the revised experimental data input. Uncertainties of 0.3% may continue to be attributed to ^{235}U, but for ^{233}U and ^{239}Pu some of the parameters are no better established than 1%. (auth)

1266 (CONF-710301–(Vol.2), pp 566-72) THERMAL PARAMETERS FOR ^{233}U. Steen, N. M. (Bettis Atomic Power Lab., West Mifflin, Pa.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Two recent evaluations of the thermal parameters for ^{233}U, by the author and the I.A.E.A. have yielded significantly different results. A review of the two evaluations indicates that the differences are due primarily to differences in the energy dependence of the thermal cross sections and the initial values of η used in the I.A.E.A. analysis. Since these evaluations were performed further experimental confirmation has become available for the energy dependence of the thermal η used by the author. A detailed examination of the two direct determinations of η has been made and the results discussed. This work essentially confirms the earlier recommendations by the author, producing a 2200 m/s value of $\eta = 2.2978 \pm 0.007$ and $\bar{\nu}_p^{Cf} = 3.774 \pm 0.014$. (auth)

1267 (CONF-710301–(Vol.2), pp 573-83) ^{235}U FISSION CROSS SECTION FROM 10 keV TO 200 keV. Szabo, I.; Filippi, G.; Huet, J. L.; Leroy, J. L.; Marquette, J. P. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

New measurements have been made from 10 to 200 keV to improve the ^{235}U and ^{239}Pu fission data sets previously published. The time-of-flight technique has been used and a new fast response ionization chamber has been built; the walls are thin enough to reduce the scattering correction to about 3%. The two fissile foils have been fabricated and assayed by C.B.M.N. (GEEL). Comparison is made with the results of other laboratories. (auth)

1268 (CONF-710301–(Vol.2), pp 591-7) MEASUREMENTS OF THE CAPTURE-TO-FISSION RATIO FOR ^{235}U. Vorotnikov, P. E.; Vukolov, V. A.; Koltypin, E. A.; Molchanov, Yu. D.; Yankov, G. B. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The neutron capture-to-fission cross-section ratio for ^{235}U has been measured for incident neutron energy range from 5 to 50 keV simultaneously and at 130 keV separately. This report contains a brief description of experimental techniques and the results obtained. The corrections introduced into experimental data are briefly discussed and some results obtained by other authors are given. (auth)

1269 (CONF-710301–(Vol.2), pp 605-10) EVALUATION OF ETA FOR ^{233}U AT 0.025 eV USING MONTE CARLO (LWBR DEVELOPMENT PROGRAM). Mitchell, J. A.; Emert, C. J. (Bettis Atomic Power Lab., West Mifflin, Pa.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The measurement of eta for ^{233}U by Smith, et al. with monochromatic neutrons at 0.025 eV has been studied with Monte Carlo. The present study extends that of Emert, et al. by improved cross section treatment, greater physical detail and, most importantly, by small statistical error. This analysis confirms Smith's η value with high precision. The IAEA evaluation of η falls at the 90% confidence limit for the value of η in this study. The sensitivity of this study to uncertainties in cross sections and inventory has been evaluated. (auth)

1270 (CONF-710301–(Vol.2), pp 628-57) STATUS AND COMPARISON OF TECHNIQUES FOR RESONANCE MEASUREMENTS. Moore, M. S. (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The three types of facility which have proved useful for time-of-flight measurements in the resonance region are (1) the fast chopper with a high flux reactor, (2) the pulsed electron linear accelerator or charged-particle accelerator, creating bursts of neutrons by (γ,n) or (p,xn) reactions, and (3) the nuclear explosion, giving a single intense neutron burst. The general utility of these three approaches can be assessed by considering the energy ranges over which high quality data have been taken: $\lesssim$100 eV for the fast chopper, $\gtrsim$20 eV for the nuclear explosion, and the entire range for the accelerators. Each facility has its unique advantages. The fast choppers have concentrated on total cross sections of small samples and high resolution gamma-ray spectra in resonances. The nuclear explosion is optimum for cross sections of highly radioactive materials. The accelerator sources are most useful for partial cross sections of long-lived or stable species. No measurement of resonance neutron cross sections is complete without an analysis. Highly developed techniques of area analysis are the most widely used, but least-squares shape analysis is required when interference phenomena are important. (auth)

1271 (CONF-710301–(Vol.2), pp 658-66) CROSS SECTION AND NEUTRON RESONANCE PARAMETERS OF ^{238}U. Rahn, F. J.; Camarda, H.; Hacken, G.; Havens, W. W. Jr.; Liou, H. I.; Rainwater, J.; Slagowitz, M.; Wynchank, S.; Arbo, J.; Ho, C. (Columbia Univ., New York).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Neutron transmission, capture and self-indication measurements have been carried out on the isotope ^{238}U over an energy region from a few eV up to more than 5 keV to determine the cross section, resonance parameters, level densities and the s-wave strength function. These measurements were performed at the Nevis Neutron Velocity Spectrometer using several different sample thicknesses ranging between 1/n = 8.47 and 478 barns/atom. The best resolution was 0.1 n sec/meter for the transmission data and 0.5 n sec/meter for the capture and self-indication data. The total radiation width Γ_γ has been determined for 71 levels up to 2400 eV. The radiation widths were found to have an average value of $\langle\Gamma_\gamma\rangle$ = [22.9 ± 0.5 (statistical) ±0.9 (systematic)] MeV and were distributed about this mean with a best fitting chi-squared distribution of 70 degrees of freedom. The value of the s-wave strength function from the analysis was $S_0 = (1.02 \pm 0.10) \times 10^{-4}$. (auth)

1272 (CONF-710301–(Vol.2), pp 667-72) PARAMETERS OF ^{237}Np RESONANCES BELOW 70 eV. Poortmans, F.; Ceulemans, H. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Theobald, J.; Migneco, E. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Total and scattering cross section measurements on ^{237}Np have been performed at a 30 meter time-of-flight station of the linac of C.B.N.M., Euratom, Geel. The results of these experiments have been combined with the results of recent capture cross section measurements on this isotope, made at the same institute. The resonance parameters, including spin, have been obtained for 12 resonances. Among them are four resonances which probably belong to the first cluster of fission resonances around 40 eV and which have all four the same spin J = 2. The mean capture width is found to be different for the two classes of resonances: $\langle\Gamma_\gamma\rangle_{J=3}$ = 47 MeV and $\langle\Gamma_\gamma\rangle_{J=2}$ = 57 MeV. (auth)

1273 (CONF-710301–(Vol.2), pp 680-7) MEASUREMENT AND ANALYSIS OF TOTAL CROSS SECTION OF Ho, Tm, AND STABLE ISOTOPES OF Te AND Nd. Tellier, H.; Newstead, C. M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

High resolution transmission measurements were carried out on Ho, Tm and the stable isotopes of Te and Nd using the Saclay 60 MeV electron linac as a pulsed neutron source. The Ho and Tm samples were cooled to 77°K to reduce Doppler broadening. The parameters of more than 1500 resonances were obtained by single level Breit–Wigner shape analysis. The values of the s-wave strength function S are given and compared to coupled-channel optical model calculations. (auth)

1274 (CONF-710301–(Vol.2), pp 688-94) TOTAL NEUTRON CROSS SECTION MEASUREMENTS ON STABLE RUTHENIUM ISOTOPES 99, 100, 101, 102, AND 104. Priesmeyer, H. G.; Jung, H. H. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The total neutron cross sections of the stable ruthenium isotopes 99, 100, 101, 102, and 104 have been measured by fast chopper time-of-flight spectrometry between 1 and 1500 eV. Different sample thicknesses of natural ruthenium and separated ruthenium isotopes have been used to determine parameters by area analysis for 51 resonances. Most of them could be assigned isotopically. Values for Γ_γ are given for 99 Ru and 101 Ru. Average level spacings per spin state, D, and strength functions, S, are derived from the resonance parameters for 99, 100, 101, 102, and 104 Ru. (auth)

1275 (CONF-710301–(Vol.2), pp 701-6) TOTAL NEUTRON CROSS SECTION MEASUREMENTS OF ^{238}U. Carraro, G.; Kolar, W. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The neutron total cross section of ^{238}U has been measured from 60 eV up to 14 keV. In the meanwhile another total cross section measurement in the energy range from 760 eV up to 3600 eV with a sample thickness of $0.644 \cdot 10^{-2}$ atom/barn (99.6% ^{238}U) has been performed. The observed resonances have been analyzed using the area program of S. E. Atta and J. A. Harvey (ORNL-3205 (1961)). The results confirm those obtained previously. The statistical properties have been calculated in combining the results of the energy ranges 60 to 760 eV and 3600 to 5800 eV, with the results of the present work. One determines $\langle D\rangle = (17.8 \pm 0.9)$ eV, $\langle\Gamma_n^0\rangle = (2.01 \pm 0.2) \cdot 10^{-3}$ eV, $S_0 = (1.13 \pm 0.13) \cdot 10^{-4}$ assuming that all observed resonances in the energy range up to 2000 eV are due to S-wave neutrons. (auth)

1276 (CONF-710301–(Vol.2), pp 707-13) SINGLE LEVEL ANALYSIS OF ^{241}Pu NEUTRON RESONANCES. PART I. NEUTRON WIDTHS. Kolar, W.; Carraro, G. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The total neutron cross section of ^{241}Pu has been measured in the energy range 0.7 to 700 eV. The experiments were carried out at the 60 MeV electron linear accelerator of the CBNM. The sample thickness was 0.7 gr/cm^2 Pu enriched to about 95% of ^{241}Pu. The nominal resolution varied between 100 nsec/m at 0.7 eV and 1 nsec at 700 eV. From 12 to 100 eV the results have been analyzed using the single level shape fit program of S. E. Atta and J. A. Harvey. From the resonance parameters one calculates $\langle D\rangle = (1.00 \pm 0.10)$ eV, $\langle 2g\Gamma_n^0\rangle = (0.296 \pm 0.06) \cdot 10^{-3}$ eV and $S_0 = (2.49 \pm 0.7) \cdot 10^{-4}$ assuming that all observed resonances are due to s-wave neutrons. (auth)

1277 (CONF-710301–(Vol.2), pp 714-20) PRACTICAL MODEL FOR GENERATING RESONANCE ENERGY CROSS SECTIONS FOR HEAVY NUCLIDES. McCrosson, F. J. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Resonance energy differential absorption cross sections were generated for nuclides in the range ^{230}Th–^{254}Cf by making simplifying assumptions concerning resonance structure and requiring that the differential cross section be consistent with known resonance integral data. Resonance structure was characterized by the Breit–Wigner single level formalism assuming the spacing between resonances, Γ_n^0, Γ_γ, Γ_f, and g to be independent of resonance energy. Averaged values for these resonance parameters were obtained from conventional statistical models. To demonstrate the applicability of the generated cross sections in reactor calculations, spectrum averaged neutron absorption rates computed from both measured and generated cross section data were compared for various degrees of resonance self-shielding and spectrum hardness. (auth)

1278 (CONF-710301–(Vol.2), pp 721-7) RESONANCE PARAMETERS OF ^{240}Pu FROM 20 TO 500 eV. Hockenbury, R. W.; Boice, J. D.; Moyer, W. R.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Neutron absorption and transmission measurements were made on ^{240}Pu from 20 eV to about 1 keV as part of an experiment to measure the keV capture cross section. A high-low bias technique was used in the absorption measurements to separate the fission and capture components and upper limits can be set on the fission widths of these resonances. The capture data were normalized in two ways: (1) by the saturated capture method and (2) to transmission data where both capture and transmission give essentially the same result, gΓn. The normalizations agree within statistics. The advantages and sources of error of each method are examined. These data have been analyzed for resonance parameters. The results for the radiation widths are 15 to 25% larger than previously reported values. (auth)

1279 (CONF-710301–(Vol.2), pp 728-34) MEASUREMENT OF NEUTRON CROSS SECTIONS IN ^{238}U AND ^{235}U BELOW 100 keV AT THE ORELA. Silver, E. G.; de Saussure, G.; Perez, R. B.; Ingle, R. W. (Oak Ridge National Lab., Tenn.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The ^{238}U(n,γ) and ^{235}U(n,f) cross sections have been measured using a large scintillation detector in a split-halves coincidence mode, up to 100 keV energy. Special care has been taken in making sample-thickness corrections to the observed ^{238}U(n,γ) data, with significant results. The ^{235}U(n,f) cross section has been measured both with a fission chamber and by the two-bias technique. Results are presented and compared with other work. Fission-to-capture ratio measurements are presented for ^{235}U including the gap hitherto found between 2 and 20 keV. (auth)

1280 (CONF-710301–(Vol.2), pp 735-42) ^{232}Th NEUTRON CAPTURE IN THE REGION 20 eV TO 30 keV. Forman, L.; Schelberg, A. D.; Warren, J. H.; Harlow, M. V.; Grench, H. A.; Glass, N. W. (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971)

The ^{232}Th neutron capture cross section has been measured from 20 eV to 30 keV on the Physics-8 underground explosion. Resonance parameters and systematics for s-wave and p-wave levels that were obtained in the resolvable region, to 2,000 eV, were used directly to calculate the average cross sections in the unresolved region. These calculations were in good agreement with the measured cross section. The results do not support the Porter–Thomas postulate for single channel reactions. (auth)

1281 (CONF-710301–(Vol.2), pp 743-8) NEUTRON CAPTURE AND γ-RAY SPECTRA MEASUREMENTS IN RESOLVED RESONANCES FOR THE ODD Nd ISOTOPES. Rohr, G.; Weigmann, H.; Heske, M. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Neutron capture on separated odd Nd-isotopes has been studied at the linear accelerator in the energy range from 40 eV to 1.5

keV and 2.0 keV for ^{145}Nd and ^{143}Nd respectively. The measurements were performed at a 60 m flight path with a modified Moxon–Rae detector. Totally 125 resonances have been analyzed with an area analysis program, taking into account multiple scattering. The γ-ray spectra in resolved resonances were measured at 8.3 m with a Ge(Li)-detector in the energy range from 4 eV to 320 eV and 660 eV respectively. The different population of low lying states from resonances with different spin is used for resonance spin determination. No evidence for a spin dependence of Γ_γ is observed. (auth)

1282 (CONF-710301–(Vol.2), pp 749-56) NEUTRON CAPTURE MEASUREMENTS AND RESONANCE PARAMETERS OF Mo ISOTOPES. Weigmann, H.; Rohr, G.; Winter, J. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Neutron radiative capture in resonances of separated Mo-isotopes has been measured at a 60 m flight path of the CBNM electron linac. Resonance area analysis yields $g\Gamma_n$ for small resonances or $g\Gamma_\gamma$ for large ones. A statistical analysis of available data on neutron widths of the odd isotopes yields s- and p-wave strength functions. Some rather strong resonances in ^{98}Mo have been identified as p-wave from measurements of the γ-ray spectra. Additional data from elastic scattering and self-indication measurements allow a complete determination of the parameters of these resonances. A parity dependence of the total radiative widths is observed and explainable with the aid of the observed γ-ray spectra. (auth)

1283 (CONF-710301–(Vol.2), pp 764-70) NEUTRON CAPTURE CROSS SECTION OF ^{207}Pb. Allen, B. J.; Macklin, R. L. (Australian Atomic Energy Commission. Oak Ridge National Lab., Tenn.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The neutron capture cross section of ^{207}Pb has been measured from 3 keV to 640 keV with total energy detectors at the Oak Ridge Electron Linear Accelerator. Two measurements were made at 40 meters with pulse widths of 5 and 40 nsec on 10.47 and 0.57 g cm^{-2} samples of separated ^{207}Pb. The capture cross section is obtained relative to that of gold. Shape analysis of the 41 keV resonance sets a new upper limit on the nonresonant capture cross section. (auth)

1284 (CONF-710301–(Vol.2), pp 785-91) SPIN ASSIGNMENTS FROM CAPTURE GAMMA-RAYS AND SCATTERING MEASUREMENTS. Cauvin, B.; Lottin, A.; Michaudon, A.; Newstead, C. M.; Paya, D.; Trochon, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Three types of experiments to determine s-wave resonance spins were carried out using the Saclay 60 MeV Linac as a pulsed neutron source. The gamma-ray multiplicity method was used to assign spins of resonances in target nuclei ^{127}I, ^{143,145}Nd, and ^{147,149}Sm and the low level occupation probability method was used to make assignments in target nuclei ^{122,123}Sb and ^{143,145}Nd. Resonant elastic scattering was employed to determine spins of resonances in target nuclei ^{123,125}Te. (auth)

1285 (CONF-710301–(Vol.2), pp 792-8) HIGH RESOLUTION CAPTURE γ-RAY SPECTROSCOPY IN FISSILE NUCLIDES. Chrien, R. E.; Dritsa, S.; Graves, R. G.; Kane, W. R.; Wasson, O. A. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Recent technological advances have made it possible to apply the methods of high resolution neutron capture γ-ray spectroscopy to fissile targets. The capture and fission components of the spectrum of γ-rays following neutron interactions can be distinguished by several methods. Perhaps the most powerful of these, however, is the examination of spectra from the various resonances with their widely varying ratios of capture to fission. Recent work carried on in the epithermal region for ^{235}U and ^{239}Pu at the BNL High Flux Beam Reactor is described. A combination of measurements involving high and low energy radiation is used, with results from radioactivity studies, to establish the structure of the residual nucleus. Once the spins and parities of the final states are known, the high energy transitions populating these states may be used with confidence to establish spin assignments for fission resonances. (auth)

1286 (CONF-710301–(Vol.2), pp 799-803) GAMMA RAYS FROM RESONANCE NEUTRON CAPTURE IN ^{232}Th. Wasson, O. A.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

New measurements of the neutron capture γ-ray spectra from four low energy resonances below 100 eV are reported for ^{232}Th. Due to the strong background activity from the 2614.47 keV γ-ray in the thorium sample only higher energy γ rays were observed. The thorium γ ray intensities are measured relative to the intensities from the 4.9 eV resonance in gold. The fluctuation of γ ray intensities are consistent with the Porter Thomas distribution which suggests that the statistical model of neutron capture may be used to calculate capture γ-ray spectra from thorium for shielding calculations. (auth)

1287 (CONF-710301–(Vol.2), pp 804-7) USE OF PRIMARY AND LOW ENERGY GAMMA RAYS FOR SPIN DETERMINATION OF S- AND P-WAVE RESONANCES. Mughabghab, S. F.; Wasson, O. A.; Cole, G. W.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The technique of using low energy γ-rays in conjunction with primary γ-rays for spin determinations in the rare earth region has proved to be a successful tool. Recently this method was applied on an enriched sample of ^{173}Yb. The γ-ray spectra due to neutron capture in individual resonances of ^{173}Yb were studied with a 4 cc GeLi detector at the 22 M station of fast chopper facility of the HFBR. The ratio of intensities of γ-rays at energies of 76 and 174 keV was formed for each resonance and was found to separate into two characteristic groups. One group included the resonances at 4.5, 35.8, 53.6, 58.9, 66.3, 74.6, and 96.5 eV while the other included the resonances at 17.7, 31.3, 45.3, 69.1, 76.3, 106, and 111 eV. Since the spin of the former group is J = 3 on basis of observation of primary γ-ray transitions to known J = 4 final states, spin J = 2 was assigned to the latter. In addition, the applicability of this method to P-wave capture in ^{98}Mo is explored. (auth)

1288 (CONF-710301–(Vol.2), pp 808-11) IDENTIFICATION OF PARITY OF RESONANCES FROM PRIMARY γ-RAY TRANSITIONS. Mughabghab, S. F.; Wasson, O. A.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Because of the Porter–Thomas fluctuations of reduced neutron widths, it is in principle not possible to determine the S- or P-wave nature of neutron resonances totally on the basis of the "strength" of a resonance. However, the use of primary γ-rays populating final states with known spin can yield definite information about the parity of resonances. Primary γ-ray spectra due to neutron capture in the isotopes ^{92}Mo, ^{96}Mo, ^{98}Mo, and ^{100}Mo were studied and spin and parities $J^\pi = 3/2^-$ were assigned to the following resonances: 347, 2040, 5040 eV in ^{92}Mo, 113.4 in ^{96}Mo, 12, 818, and 1108 eV in ^{98}Mo and possibly 97.3 in ^{100}Mo. The ^{98}Mo resonances at 429 and 612 eV have $J^\pi = 1/2^-$. (auth)

1289 (CONF-710301–(Vol.2), pp 812-15) VALENCY NEUTRON TRANSITIONS IN RADIATIVE NEUTRON CAPTURE. Mughabghab, S. F.; Chrien, R. E.; Wasson, O. A.; Cole, G. W.; Bhat, M. R. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A study of γ-ray intensities following P-wave neutron capture in ^{92}Mo and ^{98}Mo shows that a simple reaction mechanism dominates the decay of the compound nuclear state. The intensities are largely accounted for by the motion of a valency neutron in transitions of the types: $p_{\frac{1}{2}} \rightarrow d_{\frac{3}{2}}, d_{\frac{5}{2}}$ or $p_{\frac{3}{2}} \rightarrow s_{\frac{1}{2}}, d_{\frac{3}{2}}$. (auth)

1290 (CONF-710301–(Vol.2), pp 823-8) SINGLE LEVEL ANALYSIS OF ^{241}Pu NEUTRON RESONANCES. PART II. FISSION WIDTHS. Kolar, W.; Theobald, J. P.; Wartena, J. A. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The transmission and fission cross section time-of-flight measurements on ^{241}Pu performed at the CBNM at Geel have been analyzed with single level shape fitting programs. The parameters of resonances between 12 and 100 eV are presented and discussed. (auth)

1291 (CONF-710301–(Vol.2), pp 829-35) MEASUREMENT AND ANALYSIS OF THE FISSION CROSS SECTIONS OF ^{233}U AND ^{235}U FOR NEUTRON ENERGIES BELOW 30 keV. Blons, J.; Derrien, H.; Michaudon, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Fission cross section measurements of ^{233}U and ^{235}U were carried out using the Saclay linac as a pulsed neutron source for neutron energies below 30 keV with a nominal resolution of 1 ns/m. In these measurements, the samples were cooled down to 77°K in order to reduce the Doppler effect which otherwise would predominate up to 700 eV. For ^{235}U, single-level analysis of the Saclay fission and total cross sections leads to the resonance parameters up to 150 eV. (auth)

1292 (CONF-710301-(Vol.2), pp 836-42) MEASUREMENT OF THE FISSION CROSS SECTION AND ANALYSIS OF THE TOTAL AND FISSION CROSS SECTIONS OF ^{241}Pu IN THE RESONANCE REGION. Blons, J.; Derrien, H.; Michaudon, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Fission cross section measurements of ^{241}Pu were carried out using the Saclay linac as a pulsed neutron source for neutron energies below 30 keV with a nominal resolution of 1 ns/m. In these measurements, the samples were cooled down to 77°K in order to reduce the Doppler effect which otherwise would predominate up to 700 eV. Single level analysis of this fission cross section σ_f (and of the total cross section σ_T, as measured at C.B.N.M., Geel) leads to the resonance parameters up to 160 eV. At lower energy, examples of multilevel analysis of these cross sections will be given. (auth)

1293 (CONF-710301-(Vol.2), pp 848-54) INFLUENCE OF INTERMEDIATE STRUCTURE IN SUBTHRESHOLD FISSION ON SELF SHIELDING FACTOR AND DOPPLER EFFECT. L'Heriteau, J. P.; Neviere, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The influence of subthreshold fission structure for ^{240}Pu and in the 1^+ channel for ^{239}Pu on effective cross sections and Doppler effect was studied. In the unresolved resonance region two sets of resonance parameters simulating the cross sections in a range of the spacing of the structure were generated. The first set was calculated with random parameters generated according to Wigner and Porter-Thomas laws, the second with random parameters whose average values are modulated by the subthreshold fission structure. The two sets were put in the REDITE code which computes the self-shielding coefficients and the effective cross sections from which the influence on Doppler effect for two temperatures were deduced. (auth)

1294 (CONF-710301-(Vol.2), pp 855-60) CROSS SECTIONS AND FRAGMENT ENERGY DISTRIBUTIONS IN THE LOW ENERGY NEUTRON INDUCED FISSION OF ^{233}U. Felvinci, J. P.; Melkonian, E. (Columbia Univ., New York).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Neutron times-of-flight and fission fragment energies were recorded event by event on magnetic tape in an experiment using the Nevis synchrocyclotron as a pulsed neutron source. These data were treated to yield the fission cross section of ^{233}U from 0.1 to 10^5 eV. The results are compared with previous experiments and found to be of better quality in some aspects. The partial fission cross sections for several narrow bands of fission fragment energies show differences similar to effects found in ^{239}Pu and ^{235}U. The interpretation of this variation assuming channel effects is presented. (auth)

1295 (CONF-710301-(Vol.2), pp 868-75) NEUTRON SCATTERING CROSS SECTION OF ^{197}Au. Hoffman, Marvin M.; Berzins, George J.; Sanders, Wm. Mort; Brown, Leon J.; Phillips, Donald D. (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The neutron scattering cross section of gold has been measured over the interval from 25 eV to 1 MeV. The experiments were performed at the Nevada Test Site using a moderated thermonuclear neutron pulse and ^3He scintillator type neutron detectors. A 260 meter evacuated flight path and the moderating assembly resulted in a TOF resolution of approximately 0.5 ns/m in the energy region above 500 eV. Differential scattering cross sections at 40° and 90° have been obtained. Neutron-capture gamma ray data were also recorded. Elastic scattering and capture resonances were well resolved up to 2 keV. (auth)

1296 (JINR-P7-5920) PRODUCTION OF NEW PROTACTINIUM ISOTOPE ^{216}Pa WHEN BOMBARDING OSMIUM BY PHOSPHORUS AND GOLD BY MAGNESIUM. Sun-Tsin-Yan, G. Yu.; Druin, V. A.; Trofimov, A. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

A new isotope ^{216}Pa was synthesized when bombarding ^{189}Os and ^{190}Os with ^{31}P ions and ^{197}Au with ^{24}Mg ions. This isotope has the half-life $T_{\frac{1}{2}} = 0.20 \pm 0.04s$ and a complex α-spectrum with the peaks $E_\alpha = 7.72$; 7.82 and 7.92 MeV. The cross section of the nuclear reaction $^{190}Os(^{31}P,5n)^{216}Pa$ in the maximum is of 10^{-30} cm^2. (auth)

1297 INTEGRAL REACTION RATE DETERMINATIONS. PART II. FISSION RATE MEASUREMENTS. Draper, E. Linn Jr. (Cornell Univ., Ithaca, N. Y.). Nucl. Sci. Eng.; 46: No. 1, 31-41(Oct 1971).

Integral fission rates were measured for ^{232}Th, ^{233}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am, ^{242m}Am, and ^{243}Am in four tailored epicadmium neutron spectra. The fission rates were determined by counting fission-fragment tracks in solid-state track recorders. The measured and calculated fission rates differed by <7% for ^{232}Th, ^{233}U, ^{235}U, ^{236}U, ^{238}U, and ^{237}Np in each spectrum. There is evidence that the ^{232}Th, ^{238}U, and ^{237}Np differential data need slight normalization corrections. ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am, ^{242m}Am, and ^{243}Am each exhibited larger deviations of measured from calculated activities than the lighter nuclides. The magnitude of the deviations varied from one spectrum to another for some materials; this variation indicates the possibility of not only magnitude but also shape uncertainties for the differential cross sections. (auth)

1298 DETERMINATION OF ACCUMULATION RATE OF ACTINIDE-ELEMENT ISOTOPES IN SM-2 REACTOR CORE. Gabeskiriya, V. Ya.; Davidenko, V. A.; Zamyatnin, Yu. S.; Prokopenko, V. S.; Chetverikov, A. P. At. Energ. (USSR); 31: No. 3, 221-2(Sep 1971). (In Russian).

Thin samples of ^{240}Pu, ^{241}Am, and ^{243}Am were irradiated inside the fuel assembly of the SM-2 reactor. An isotopic composition of Pu, Am, and Cm extracted from the irradiated samples shows that the neutron absorption cross sections, $\hat{\sigma}_\alpha$, of even-even and odd-even nuclei substantially increase with increasing resonance neutron fraction in the spectrum. For the hard spectrum of the SM-2 core $\hat{\sigma}_\alpha$ (^{240}Pu) = 2900 ± 100b, $\hat{\sigma}_\alpha(^{241}Am)$ = 1800 ± 100b; equilibrium isotopic ratio $^{242m}Am/^{241}Am = 0.04$, $^{245}Cm/^{244}Cm = 0.14$. (auth)

1299 CALCULATIONS OF BETA ENERGY RELEASE RATES FOLLOWING THERMAL NEUTRON INDUCED FISSION OF ^{233}U, ^{235}U, ^{239}Pu, AND ^{241}Pu. Scobie, J.; Scott, R. D. (Scottish Research Centre, Glasgow). J. Nucl. Energy; 25: No. 8, 339-46 (Aug 1971).

Results are presented of calculations of the beta energy release rate as a function of time following a 10^4-sec irradiation by thermal neutrons of the isotopes ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu. Reasons for the differences in the release rates are discussed; and it is concluded, on the basis of the mass yield curves, that the results would be very similar if fission were induced by fast rather than by thermal neutrons. The calculated results for ^{239}Pu are found to agree well with the single set of measurements for that isotope. (auth)

1300 ANGULAR CORRELATION STUDY ON THE 321 TO 177 keV CASCADE IN ^{125}Te. Satyanarayana, Gummadi; Lakshminarayana, V. (Andhra Univ., Waltair, India). Curr. Sci. (India); 40: No. 17, 458-9(5 Sep 1971).

Angular correlation coefficients were measured for the 321-177 keV cascade in ^{125}Te. A gamma coincidence spectrum is shown. It is estimated that there is a quadrupole content of (0.07 ± 0.05%) in the E1 transition. (R.W.R.)

1301 MAGNETIC PROPERTIES OF ^{153}Eu, ^{155}Eu, AND ^{189}Os NUCLEI. Begzhanov, R. B.; Gaffarov, D. G.; Muminov, A. I.; Radzhapov, P. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 43-8(1971). (In Russian).

Experimental results are given for measurements of lifetimes, attenuation factors, gamma angular correlations, and g factors of excited states of ^{153}Eu(103.2 keV), ^{155}Eu(105 keV), and ^{189}Os (69 and 95 keV). A fast-slow coincidence circuit with a time-to-amplitude converter was employed in the measurements. The sources $^{153}Sm(T_{\frac{1}{2}} = 47$ hr) and $^{155}Sm(T_{\frac{1}{2}} = 22$ min) were obtained by irradiating a natural mixture of Sm_2O_3 and enriched (98.8%) ^{154}Sm in a slow-neutron flux of 1.2×10^{12} n/cm-sec. Natural osmium was irradiated in an 18-MeV proton beam from a cyclotron. (K.S.W.)

1302 TWO-DIMENSIONAL (T,E_γ) MAPPING OF SHORT-LIVED NUCLIDES. Nagy, A. Z.; Csoke, A.; Szabo, E. (Central Research Inst. for Physics, Budapest). J. Radioanal. Chem.; 7: No. 2, 365-81(Mar 1971).

Nuclides with half-lives between 0.1 msec and 60 sec and decay gamma rays of 0.01 to 10 MeV are plotted on a T vs E_γ map. Activation reactions, half-lives, abundances, major radiations, neutron cross sections, and threshold energies are given. The aim of this work was to establish the usefulness of these activities for activation analysis with the use of different types of neutron sources. (R.W.R.)

1303 DIRECT γ SPECTROMETRIC ANALYSIS OF ^{235}U FISSION PRODUCTS. APPLICATION TO THE MASS DISTRIBUTION OF PRODUCTS FROM THE FISSION OF ^{232}Th BY 14-MeV NEUTRONS. Blachot, J.; Carraz, L. C.; Cavallini, P.; Monnand, E.; Schussler, F. (CEN, Grenoble, France). J. Radioanal. Chem.; 7: No. 2, 309-17(Mar 1971). (In French).

The γ spectra of ^{235}U fission products are analyzed by a Ge(Li) detector after cooling times of 3, 7, and 110 hr. The possibility of the use of these results is demonstrated for measuring the mass distribution. Some preliminary values for the fission of ^{232}Th by 14-MeV neutrons are given. (auth)

1304 SPONTANEOUS FISSION OF HEAVY TRANSURANIUM ELEMENTS IN THE SURFACE LAYERS OF THE PECULIAR A STAR HR 465 EXPLAINS PROMETHIUM ABUNDANCE. Kuchowicz, B. (Univ., Warsaw). Nature (London); 232: No. 5312, 551-2(20 Aug 1971).

It is stated that there is strong evidence for the presence of Pm lines in the peculiar A star HR 465; and it is considered that a search for transuranium elements in the spectra of these stars, and in particular those in which U or Pm has been detected, should show positive results. It may even be possible to find spectral lines of superheavy elements from the "island of stability" near Z = 114. Some arguments are presented for the hypothesis that the Pm observed in HR 465 is continuously produced in the spontaneous fission of very heavy transuranium elements. Pm cannot be regarded as a rare fission product of the heavier fissioning nuclei; provided large amounts of such nuclei were produced in the exploding primary component of a binary system and were then transferred to the surface of a recent Ap star, they would be a continuous source of Pm. Observation of Pm seems to confirm the existence of superheavy elements suggested by other data. (UK)

1305 PREDICTIONS OF THE ENERGY DEPENDENCE OF THE AVERAGE YIELD OF NEUTRONS PER FISSION OF ISOTOPES OF THORIUM, URANIUM, AND PLUTONIUM. Howerton, Robert J. (Univ. of California, Livermore). Nucl. Sci. Eng.; 46: No. 1, 42-52(Oct 1971).

A formalism developed in 1963 [Schuster and Howerton, Nucl. Energy, Parts A/B, 18, 125 (1964)] for predicting the energy dependence of the average neutron yield per fission, $\bar{\nu}$, is tested against post-1963 experiments. It is shown that the 1963 formalism accounts adequately for $\bar{\nu}(E)$ for uranium isotopes but is inadequate for isotopes of other species. A revised formalism is presented which accounts for the Z dependence of $\bar{\nu}(E, A, Z)$ by inclusion of a first-order term in Z. The coefficient of the Z-dependent term is derived from consideration of detailed measurements of $\bar{\nu}(E)$ for ^{239}Pu. The resulting equation is used to calculate $\bar{\nu}(E, A, Z)$ for isotopes of plutonium, uranium, thorium, and thermal values of americium isotopes. ^{235}U, ^{238}U, and ^{239}Pu are the only isotopes that have detailed measurements of $\bar{\nu}(E)$ over a large range in energy made by a single experimental group. The equation predicts these measured values of $\bar{\nu}(E, A, Z)$ to better than 0.5% in first moment and standard deviations to better than 1.5% about the central point of the measurements. This result suggests that the extended formalism is a useful tool for prediction of $\bar{\nu}(E, A, Z)$ for isotopes having no measurement. (auth)

1306 ^{208}Pb(t,p)^{208}Pb AND ^{210}Pb(p,t)^{208}Pb REACTIONS AT 20 MeV. Igo, G. (Los Alamos Scientific Lab., N. Mex. Univ. of California, Los Angeles); Barnes, P. D.; Flynn, E. R. Ann. Phys. (N. Y.); 66: No. 1, 60-116(Jul 1971).

The ^{208}Pb(t,p)^{208}Pb and ^{210}Pb(p,t)^{208}Pb reactions were studied at 20 MeV up to an excitation of 6.75 MeV in the (p,t) reaction and up to 8.5 MeV in the (t,p) reaction. Angular distributions of 10° to 80° were observed in both reactions. The spin and parity of about thirty states were tentatively identified from their angular distribution patterns and by comparison of the cross sections measured in the (p,t), (t,p), (p,p'), and (d,p) reactions. Pairing-vibrational states (0^+ and 2^+) are identified, and the presence of a proton pairing-vibrational state (0^+) at 5.24 MeV is suggested by the data. Two-neutron-transfer DWBA cross sections are calculated for about 50 states by using one-particle–one-hole wavefunctions. These wavefunctions are characterized by appreciable percentage in the valence neutron particle (hole) configurations of ^{210}Pb(^{206}Pb). Tentative identification with observed states allows a quantitative comparison. The strongly populated pairing-vibrational states are compared with DWBA calculations using the valence neutron wavefunctions of True and Ford [Phys. Rev., 109: 1675(1958)] and Redlich [Phys. Rev., 138: B544(1965)] for ^{206}Pb and ^{210}Pb. Discrepancies are discussed in terms of mixing with the analogs of higher lying 2^+ states in ^{210}Pb and in terms of the two-particle–two-hole wave functions. (auth)

1307 LEVELS OF ^{94}Mo STUDIED BY THE DECAY OF 6.3-MIN ^{94}Nb. Hayashibe, Shogo; Yoshikawa, Nobuharu; Endo, Yorimasa; Kanazawa, Masaaki; Ishimatsu, Toshiyuki (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 31: No. 4, 967-70(Oct 1971).

The decay of 6.3-min ^{94m}Nb to levels of ^{94}Mo was studied with a Ge(Li) detector and a Ge(Li)–NaI(Tl) coincidence spectrometer. A 0.993-MeV gamma ray coincident with the 0.871-MeV gamma transition between the first excited and ground states of ^{94}Mo was found, and a level of ^{94}Mo at 1.864 MeV is proposed. A probable spin–parity assignment of 3^+ is made to the 1.864-MeV level. (auth)

1308 DECAY SCHEMES OF ^{91}Mo AND ^{91m}Mo. de Barros, S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Maurenzig, P. R.; Baptista, G.; (and others). Notas Fis., Cent. Brasil. Pesqui. Fis.; 18: No. 3, 23-32(1970).

Seven previously unreported gamma rays in the decay of ^{91g}Mo were observed, and their energy and intensity were measured. For ^{91m}Mo two new gamma rays were observed, and the levels fed by its decay were identified with l = 1 levels found by the (^{3}He, d) reaction. (auth)

1309 PRODUCTION OF ^{237}U. Krivokhatskii, A. S.; Romanov, Yu. F. (Leningrad State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 28-31(1969). (In Russian).

Two methods of obtaining ^{237}U are examined, irradiation of ^{235}U and ^{236}U in different fluxes of neutrons from a nuclear reactor (10^{13} to 10^{16} neutrons/cm^2 sec) and the accumulation of ^{237}U in plutonium enriched by the isotope ^{241}Pu. The optimum conditions of irradiation of uranium and plutonium for maximum accumulation of ^{237}U and ^{241}Pu respectively, are estimated. The cross sections for thermal neutrons known previously were used in the calculations. (tr-auth)

1310 ABSOLUTE MEASUREMENTS OF α-RAY ENERGIES. Grennberg, B.; Rytz, A. (Bureau International des Poids et Mesures, Sevres, France). Metrologia; 7: No. 2, 65-77(1 Apr 1971).

New absolute energy measurements of α particles from 20 natural and artificial emitters are reported, some of which are first absolute values. The uniform-field 180° magnetic spectrograph is described in detail. Accurate length and field measurements and line-shape extrapolations are given special attention. A detailed error analysis is presented. (auth)

1311 NUCLEAR DATA SHEETS FOR A = 235. Artna-Cohen, Agda (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. B; 6: No. 3, 287-318(Sep 1971).

The available experimental data pertaining to the nuclear structure of A = 235 are compiled. The data from various decay and reaction experiments are compared, and level schemes combining all available information are presented. Arguments for assigning spins, parities, and Nilsson-level assignments are given together with comments about the adopted level schemes. The adopted level and decay properties are based on data received before February 1971. Data received after that date are added in proof. (auth)

1312 NUCLEAR DATA SHEETS FOR A = 233. Ellis, Yurdanur A. (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. B; 6: No. 3, 257-86(Sep 1971).

Experimental data on the nuclear structure of nuclei with mass number A = 233 are compiled and compared with theory where possible. Level schemes are constructed and discussed. Arguments for spin, parity, and Nilsson-state assignments for the levels are given. The adopted level and decay properties are based on data received before March 1971. Data received after that date are added in proof. (auth)

1313 NUCLEAR DATA SHEETS FOR A = 231. Artna-Cohen, Agda (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. B; 6: No. 3, 225-55(Sep 1971).

The available experimental data pertaining to the nuclear structure of A = 231 are compiled. The data from various decay and reaction experiments are compared, and level schemes combining all available information are presented. Arguments for assigning spins, parities, and Nilsson-level assignments are given together with comments about the adopted level schemes. The adopted level and decay properties are based on data received

before February 1971. Data received after that date are added in proof. (auth)

1314 NUCLEAR DATA SHEETS FOR A = 229. Ellis, Yurdanur A. (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. B; 6: No. 3, 209-24(Sep 1971).

Nuclear structure information from decay and reaction experiments pertaining to nuclei with mass number A = 229 is compiled, evaluated, and compared with theory where possible. The level schemes that seem best in the light of the data and theoretical ideas available at this time are presented and discussed. Arguments for spin, parity, and Nilsson-state assignments for the levels are given. Additional experiments are needed to confirm some tentative spin assignments and placements of γ transitions in ^{229}Th. Experiments are also needed to construct decay schemes of Ra, Ac, Pa, U, and Np. The adopted level and decay properties are based on data received prior to March 1971. (auth)

1315 REALISTIC QUASIPARTICLE TAMM–DANCOFF CALCULATIONS IN THE ODD-MASS N = 82 ISOTONES. Miles, William Thomas. University Park, Pa.; Pennsylvania State Univ. (1970). 156p. University Microfilms Order No. 71-21,775. Thesis.

A quasi-particle Tamm–Dancoff calculation is carried out for the odd-mass N = 82 isotones ^{137}Cs, ^{139}La, ^{141}Pr, ^{143}Pm, and ^{145}Eu. The realistic matrix–elements of Elliott et al. [Nucl. Phys., A121: 241 (1968)] are used as the residual nucleon–nucleon interaction to mix states of one and three quasi particles from which spurious components have been removed. The single-particle energies are determined by a modified inverse-gap-equation method. Results are presented for spectra, wave functions, moments, transition rates, and spectroscopic factors. Comparison is made with experiment and with the results of recent calculations for these nuclei. (Diss. Abstr. Int., B)

1316 CALIBRATION AND USE OF MAGNETIC HYPERFINE FIELDS IN PERTURBED ANGULAR CORRELATION EXPERIMENTS. King, William Clifton. Lafayette, Ind.; Purdue Univ. (1971). 139p. University Microfilms Order No. 71-20,485. Thesis.

The room-temperature internal magnetic fields of ^{187}Os in Fe and Ni lattices were measured by ferromagnetic nuclear resonance methods to be $H_{int}(296°K) = -1093.43 \pm .65$ kOe and $H_{int}(295°K) = -282.3 \pm 1.0$ kOe, respectively. The internal fields for Os in Fe and Ni were used in perturbed-angular-correlation measurements to establish the magnetic dipole moment of the first 2^+ state in ^{192}Os to be $0.797 \pm .036$ nm. Perturbed-angular-correlation measurements, using the internal field of Pt in Ni, have established the magnetic dipole moment of the first 2^+ state in ^{192}Pt to be $0.90 \pm .11$ nm. Significantly, the measured magnetic moments are in agreement with the hydrodynamical 2(Z/A) predictions, but differ appreciably from the predictions of the Kumar and Baranger pairing-plus-quadrupole model. The room-temperature ^{103}Rh resonance in Fe was observed at a frequency of $69.80 \pm .02$ MHz (296°K). A ^{103}Rh–^{100}Rh$^{(2+)}$ hyperfine anomaly was determined to be -3.6 ± 0.2 percent. (Diss. Abstr. Int., B)

1317 RANGES OF FISSION PRODUCTS IN GASES. Pickering, Miles Gilbert. Stony Brook, N. Y.; State Univ. of New York (1971). 109p. University Microfilms Order No. 71-21,690. Thesis.

Range distribution measurements in H_2, He, Ne, and Ar were made for the following products produced in the spontaneous fission of ^{252}Cf: ^{97}Zr, ^{99}Mo, ^{105}Rh, ^{112}Pd, ^{115}Cd, ^{132}Te, and ^{143}Ce. The mean range values are compared to recent tables of range-energy systematics, and a scheme is devised for the accurate estimation of kinetic energy from measured range. The width of the range distributions is separated into a contribution from the fission process and a contribution from the stopping process. This radio-chemical determination of the width of the kinetic-energy distribution in fission does not suffer from the uncertainties of mass resolution inherent in counter measurements; nevertheless, the widths determined in this work are very close to those reported from the most recent physical measurements. The range straggling due to the stopping process is significantly larger than theoretical predictions. The extensive range data in the literature for fission of ^{236}U, ^{240}Pu and ^{252}Cf is re-evaluated to give the best possible estimate of kinetic energy release in near-symmetric fission. (Diss. Abstr. Int., B)

1318 ENERGY LEVELS IN $^{114\ 116\ 118\ 120\ 122}$Cd AS OBSERVED IN THE BETA DECAY OF Ag ISOTOPES. Fogelberg, B.; Baecklin, A.; Nagarajan, T. (Swedish Research Councils' Lab., Studsvik, Sweden). Phys. Lett.; 36B: No. 4, 334-6(20 Sep 1971).

The beta decays of odd-odd Ag isotopes to even Cd isotopes with A = 114–122 have been investigated. Isomeric states have been observed in ^{116,118,120}Cd and level schemes are given for all Cd nuclei studied. (auth)

1319 PRODUCTION OF PROTON-RICH NUCLEI. Duorah, H. L. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Nature (London); 232: No. 5308, 247-8(23 Jul 1971).

An investigation is reported of the abundance distribution of the proton-rich or p-elements formed in a single event–the fission of highly excited nuclei in supernovae. It is assumed that highly excited compound nuclei such as ^{254}Cf, ^{254}Fm are produced by the bombardment of Th, U (possibly already produced in a rapid process) by ^{12}C, ^{16}O ions. It was shown that the de-excitation of compound nuclei occurs almost exclusively by neutron evaporation before fragmentation of the fissile nuclei, and since the kinetic energy of the fragments is due only to Coulomb repulsion the high exitation energy given to the target nucleus by the incident ion, accelerated at some stage of supernova conditions, can be used in processes other than projection of the fission fragments. It is likely that dissipation of this energy is by the evaporation of large numbers of neutrons, but in order to limit the increase of Z^2/A one or two protons often appear to be evaporated per ten neutrons. Assuming that the nuclei are excited to energies > 100 MeV, such that about 20 neutrons are evaporated before fission, the fission fragments will be mostly proton-rich. The following fissile nuclei are considered: ^{254}Cf, ^{256}Cf, ^{254}Fm, ^{256}Fm, ^{258}Fm, ^{260}No and ^{264}No, chosen because their lifetimes against spontaneous fission range from a few hours to about 100 days, like the half period of a complicated supervova light curve. As the p-elements are produced they are exposed for a short time to a large flux of neutrons in a rapidly expanding situation, and are thus slightly modified by neutron absorption processes. The p-elements are also substantially modified by the radiation at very high temperatures. (UK)

1320 STUDIES OF LAWRENCIUM ISOTOPES WITH MASS NUMBERS 255 THROUGH 260. Eskola, Kari; Eskola, Pirkko; Nurmia, Matti; Ghiorso, Albert (Univ. of California, Berkeley). Phys. Rev., C; 4: No. 2, 632-42(Aug 1971).

Six isotopes of element 103, with mass numbers 255 through 260, were studied by means of α-particle spectroscopy. The half-lives of the nuclides and the energies and the intensities of their α-particle groups were observed to be as follows:

^{255}Lr	22 ± 5 sec	8.37 ± 0.02 MeV (~50%)
^{256}Lr	31 ± 3 sec	8.43 ± 0.02 MeV (34 ± 4%)
^{257}Lr	0.6 ± 0.1 sec	8.87 ± 0.02 MeV (81 ± 2%)
^{258}Lr	4.2 ± 0.6 sec	8.62 ± 0.02 MeV (47 ± 3%)
^{259}Lr	5.4 ± 0.8 sec	8.45 ± 0.02 MeV (100%)
^{260}Lr	180 ± 30 sec	8.03 ± 0.02 MeV (100%)

A large number of target–projectile combinations were used in synthesizing the lawrencium isotopes. Representative excitation curves for producing the nuclides are displayed. Upper limits for decay by electron capture were determined. α-decay hindrance factors are calculated using the spin-independent equations of Preston. The α-decay energy systematics of the heaviest elements are discussed. (auth)

1321 EQUILIBRIUM DEFORMATIONS OF THE GROUND AND EXCITED STATES IN THE RARE-EARTH NUCLEI. Stepien-Rudzka, W. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol.; B2: No. 5, 583-8(Sep-Oct 1971).

The equilibrium deformations of the ground and excited states in nuclei in the rare earth region are calculated using the Nilsson model. The residual interactions are taken into account in the form of the pairing forces. Comparison is made with previous calculations of similar type, together with a suggestion of applying the idea of different deformations in ground and excited states of the nucleus in the study of analog states. (auth)

1322 TWO NEW ELEMENTS: ATOMIC NUMBERS 104 AND 105. Ghiorso, Albert (Univ. of California, Berkeley). Yale Sci. Mag.; 45: No. 1, 2-7(Oct 1970).

The sophisticated techniques used in identifying short-lived isotopes of the artificial elements 104 and 105 are described. (R.W.R.)

1323 WEAK α-ACTIVITY OF VOLATILE FRACTIONS OF LEAD-ZINC ORES. Kush, V.; Chepigin, V. I.; Ter-Akop'yan, G. M.; Bogdanov, S. D. At. Energ. (USSR); 31: No. 2, 159-61 (Aug 1971). (In Russian).

The presence of very weakly active α-emitters in nature suggests the possibility of the existence of nuclei in certain ores with an atomic number of 110 to 114. The method of α–X coincidence was employed to study sublimed fractions of Pb/Zn concentrates which exhibited an intensity of 4 counts/min·mg. Comparison with standards led to the conclusion that the activity in the Pb–Zn concentrates was ^{237}Np. (K.S.W.)

1324 PRODUCTION OF SPONTANEOUSLY FISSIONING ISOMERS OF URANIUM, PLUTONIUM, AND AMERICIUM IN NEUTRON REACTIONS. Gangrskii, Yu. P.; Nad, T.; Vinnai, I.;

Kovach, I. At. Energ. (USSR): 31: No. 2, 156-7(Aug 1971). (In Russian).

The time-of-flight method was used in the study of spontaneously fissioning isomers produced in fast neutron reactions. A beam of neutrons impinged on a 1-cm target which was surrounded by a detector. The neutrons were generated by (^{3}H + d) and (^{9}Be + d) reactions. Cross sections were measured and tabulated for several (n,n') and (n,2n) reactions leading to the spontaneously fissioning isomers: ^{231}Th, ^{234}U, ^{236}U, ^{237}U, ^{238}Pu, ^{242}Pu, ^{243}Am, and ^{242}Am. (K.S.W.)

1325 RADIOCHEMICAL DETERMINATION OF ABSOLUTE CUMULATIVE YIELDS OF FISSION FRAGMENTS IN SLOW-NEUTRON FISSION OF ^{241}Pu AND ^{239}Pu. Sorokina, A. V.; Skovorodkin, N. V.; Bugorkov, S. S.; Krivokhatskii, A. S.; Petrzhak, K. A. At. Energ. (USSR); 31: No. 2, 99-102(Aug 1971). (In Russian).

Absolute cumulative yields of ^{99}Mo, ^{14}Ba, ^{141}Ce and ^{144}Ce in the slow-neutron fission of ^{239}Pu and ^{241}Pu were determined by a radiochemical method. The number of fissions was measured by direct fission events counting of a small aliquot of the fissionable material plated on a mica-track detector and exposed simultaneously with the main sample to the same neutron flux. Absolute disintegration rates of the radionuclides studied were determined by $4\pi\beta$-counting. The yields of ^{99}Mo, ^{141}Ce and ^{144}Ce in the fission of ^{239}Pu accounted for 6.17 ± 0.19, 5.18 ± 0.13, 3.85 ± 0.09% respectively, those of ^{99}Mo, ^{140}Ba, ^{141}Ce and ^{144}Ce in the fission of ^{241}Pu being 6.15 ± 0.16, 5.64 ± 0.11, 4.81 ± 0.14 and 4.08 ± 0.14%. Errors of the yield measurements do not exceed ±5%. The yields obtained are compared with the values reported. Absolute cumulative yields of 17 rare earths and ^{91}Y in the slow-neutron fission of ^{239}Pu and ^{241}Pu have been calculated by using the yields of these elements measured relatively to the cumulative yield of ^{144}Ce. (auth)

1326 NEUTRON CROSS SECTIONS FOR RADIATIVE CAPTURE BY SILVER, ^{197}Au, ^{232}Th, AND ^{238}U NUCLEI. Stavisskii, Yu. Ya.; Tolstikov, V. A.; Chelnokov, V. B.; Samsonov, A. E.; Bergman, A. A. At. Energ. (USSR); 31: No. 2, 107-12(Aug 971). (In Russian).

The results of averaged cross-section measurements for neutron radiative capture by silver, ^{197}Au, ^{232}Th and ^{238}U nuclei in the energy region below 50 keV are presented. Normalization of energy dependence of silver and ^{197}Au cross sections has been performed according to resolved low-lying resonances and thermal capture cross sections from measurements in a graphite prism placed near the main lead prism. Normalization of energy dependence of the ^{232}Th and ^{238}U cross section has been made according to resolved low-lying resonances and radiative capture cross sections for silver and ^{197}Au. The results are compared with those of some other authors. (auth)

1327 DEFORMATION OF MASS DISTRIBUTION OF FISSION PRODUCTS IN HIGH NEUTRON FLUXES. Antsyshkin, V. G.; Zagrafov, V. G.; Rybachenko, V. F. At. Energ. (USSR); 31: No. 1, 23-7(Jul 1971). (In Russian).

The change in mass distribution of fission products is considered in the area of heavy mass fragments, both from the point of view of achieving the greatest effect and also in achieving an experimental detection of the deformation of the fission fragment yield curve. The cross section of the radiative capture of neutrons and the multiple neutron capture by fragments are discussed. Several curves are presented which illustrate the effect of the neutron number, the proton number, the neutron flux density, and choice of the fissioning nucleus (^{235}U vs ^{238}U) on the profile of the resulting distribution of mass in the fission products. (K.S.W.)

1328 EXCITATION OF SHORT-PERIOD NUCLEAR ISOMER STATES IN REACTIONS WITH α PARTICLES. Goncharov, K. S.; Klyucharev, A. P.; Pis'minetskii, S. A.; (and others) (Physical-Technical Inst., Kazan). Yadern. Fiz.; 14: No. 1, 3-13(Jul 1971). (In Russian).

Exposing various targets to α particles with energy 34.8 MeV more than 30 nuclear isomer states with the lifetimes in the range $10^{-4} - 10^{-1}$ sec were observed. The following new isomers are obtained and identified: ^{122m}I (E_γ = 30, 60, 90, 160, 190 keV; $T_{1/2}$ = 70 μsec), ^{128m}Cs (E_γ = 30, 75 keV; $T_{1/2}$ = 4.4 msec), ^{142m}Pm (E_γ = 35, 200, (230), 430 keV; $T_{1/2}$ = 2.36 msec.), ^{176m}Ta (E_γ = ~20, 35, 50 keV; $T_{1/2}$ = 1.1 msec.), ^{188m}Ir (E_γ = ~60, 145, ~200 keV; $T_{1/2}$ = 4.2 msec.). Unidentified isomer activities were observed when exposing the following targets to the α-particle beam: ^{112}Sn (E_γ = ~300 keV, $T_{1/2} \approx$ 40 μsec), Ir (E_γ = ~40, 80, 145, 175 keV, $T_{1/2} \approx$ 150 msec.), Tl (E_γ = ~70, ~120, 210, 680, 880 keV, $T_{1/2}$ = 0.9 msec.). (auth)

1329 TOTAL NEUTRON CROSS SECTION OF ^{226}Ra AT ENERGIES UP TO 300 eV. Kalebin, S. M.; Adib, M.; Rukolaine, G. V.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 14: No. 1, 22-6(Jul 1971). (In Russian).

Total neutron cross sections of ^{226}Ra were investigated in the energy region up to 300 eV. Seven neutron levels were measured and their parameters are presented. The total neutron cross section of ^{226}Ra at the thermal point (0.025 eV) was found to be 20.7 ± 1.5 barn, the neutron capture cross section is 8.3 ± 0.9 barn, the potential scattering cross section is 12.5 ± 1.5 barn. (auth)

1330 PHOTONEUTRON CROSS SECTIONS OF ^{90}Zr. Ishkhanov, B. S.; Kapitonov, I. M.; Piskarev, I. M.; Shevchenko, O. P. (Moscow State Univ.). Yadern. Fiz.; 14: No. 1, 27-30 (Jul 1971). (In Russian).

The yield curve of the ^{90}Zr photoneutron reaction is measured from threshold up to 28 MeV in 50-keV steps. The effective cross section of the reaction constructed from the yield curve by means of the Penfold–Leiss method has a complicated structure. The results of the experiment are compared with the calculations performed in the framework of the shell model. (auth)

1331 PHYSICS WITH HEAVY IONS: SUPERHEAVY ELEMENTS. Greiner, Walter (Univ., Frankfurt am Main). pp 354-93 of Plenarvortraege. Stuttgart; B. G. Teubner (1969). (In German).

From thirty-fourth physicists conference; Salzburg, Austria (29 Sep 1969). See CONF-690975.

Discussed first are the two heavy-ion accelerators that are under construction in Germany. One is based on the single resonator concept, the other one on the helical concept. Subsequently, the survey considers nuclear molecules, the periodic system of elements and its enlargement, and collective potential surfaces as well as life expectancy of superheavy elements. Finally, future possibilities of heavy-ion physics are briefly discussed with respect to superfluid structure of nuclei, possibility of natural existence of the lead-like elements 114 and 164, and information about nuclear fission. (H.B.G.)

1332 NEW ISOTOPE ^{92}Ru. Arl't, R.; Bayar, B.; Zaitseva, N. G.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 13: No. 10, 397-8 (20 May 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 13: No. 10, 556-7(20 May 1971).

AgCl was bombarded by the 660-MeV proton beam of the JINR synchrocyclotron, and the Ru and Tc fractions were separated thermochromatographically. Gamma spectra were obtained by using Ge(Li) detectors. The appearance of ^{92}Tc lines indicated the presence of the isotope ^{92}Ru, with a half-life of (2.5 ± 1) min. Various checks were made to ensure that the observed activity was really the result of ^{92}Ru decay. (R.W.R.)

1333 NUCLEAR DATA SHEETS FOR A = 111. Raman, S.; Kim, H. J. (Oak Ridge National Lab., Tenn.). Nuclear Data, Sect. B; 6: No. 1, 39-74(Jul 1971).

The 1960 version of the Nuclear Data Sheets for A = 111 was revised on the basis of experimental data received before February 1971. Data received during February 1971 were added in proof. Experimental data, adopted values, comparisons with theory, arguments for J^π assignments, and detailed level schemes are presented. Comments given by compilers serve to highlight interesting features, to focus attention on existing discrepancies, and to suggest possible new experiments. The material is organized into four parts. The level-scheme drawings together with the "Summary Sheets" represent the quintessence of the numerical data that are tabulated, with minimum essential information on experimental conditions, in greater detail in the "Data Sheets." (auth)

1334 NUCLEAR DATA SHEETS FOR A = 121. Horen, D. J. (Oak Ridge National Lab., Tenn.). Nuclear Data, Sect. B; 6: No. 1, 75-105(Jul 1971).

The literature has been surveyed for data pertaining to nuclei in the mass chain A = 121. Well over 200 papers and communications were considered, and information for approximately 100 has been included. The cutoff date was the end of February 1971. The data for this mass chain are rather fragmentary. Few spin assignments are firm. The half-life of the 8-keV isomer in ^{121}Sn is still very much in doubt. The characteristics of the levels in ^{121}Sb are not yet well defined, but the enhanced E2 component of the 66-keV transition between the 0.57308 ($\frac{1}{2}^+$) and 0.50754 ($\frac{3}{2}^+$) levels may imply a large deformation. There seems to be building a cumulation of evidence throughout the mass region A ≈ 100 to 140 indicating the presence of such a deformation at about 500 to 1000 keV of excitation. (auth)

1335 TRANSITIONAL NUCLEI. II. PROPERTIES OF THE LEVELS IN ^{153}Sm AND ^{152}Gd FROM THE DECAY OF THE ^{152m,g}Eu ISOMERIC PAIR. Barrette, J.; Barrette, M.; Boutard, A.; Lamoureux, G.; Monaro, S. (Univ. of Montreal). Can. J. Phys.; 49: No. 19, 2462-95(1 Oct 1971).

The γ rays emitted in the decay of the ^{152m,g}Eu isomeric pair were studied with the use of high-efficiency, high-resolution, solid-state detectors. These measurements together with Ge(Li)–Ge(Li) coincidence experiments revealed the existence of several new gamma transitions never previously reported. In all, 93 and 30 γ rays were observed in the decay of ^{152g}Eu and ^{152m}Eu, respectively. Calculations of the β- and γ-band mixing into the ground-state rotational band and into each other were carried out. These calculations showed that this mixing is insufficient in explaining the B(E2) ratios from the members of both the β and γ band. In addition, the very likely existence of a $K^\pi = 2^-$ band in ^{152}Sm, with levels at 1649.90 (2^-) and 1757.0 keV (3^-), was unveiled in these measurements. Furthermore, the existence of a new $K^\pi = 0^-$ octupole rotational band (levels at 1680.58 (1^-) and 1730.3 (3^-)) built on the β-vibrational band and the presence of a collective $K^\pi = 2^+$ vibrational state at 1769.1 keV, which most probably can be described as a coupled ($\beta\gamma$) two phonon state, are also proposed. Moreover, a new level at 1292.75 keV was established through coincidence experiments in ^{153}Sm. This level may be considered either as the 2^+ member of a second β-vibrational band, or, more likely, can be described as a truly spherical state in light of recent experiments involving (t,p) and (p,t) transfer reactions to levels of ^{152}Sm. Finally, a qualitative analysis of the level structure of ^{152}Gd, as well as ^{150}Sm, seems to show that these two nuclei display a more rotational nature than a spherical (or vibrational) one as previously suggested. (auth) (Canada)

1336 DETERMINATION OF FISSION RATE, DECAY CONSTANT, PROFILES, AND DISTRIBUTIONS OF ^{252}Cf, ^{239}Pu, AND ^{235}U FISSION SOURCES BY SOLID STATE TRACK DETECTORS. Khan, Hameed Ahmed (Univ. of Birmingham, Eng.). Nucleus (Karachi); 8: No. 1-2, 63-75(Jan-Jun 1971).

The use of a new type of detector, called the solid state track detector (SSTD), is made in the determination of the spontaneous fission rate and the fission decay constant of a ^{252}Cf spontaneous fission source. Also, they are used in finding profiles and distributions of fission sources like ^{235}U, ^{239}Pu, and ^{252}Cf. (auth)

1337 SEARCH FOR SUPERHEAVY ELEMENTS USING NUCLEAR SYNTHESIS. Lefort, M. (Paris Univ., Orsay, France). Ann. Phys. (Paris); 5: No. 6, 355-76(Nov 1970). (In French).

The possible existence of a new stability zone (around Z = 112 to 126 and N = 184), and the very special properties that nuclei in this zone should possess, are discussed. Current methods available for synthesizing such nuclei in the laboratory are reviewed. The method of inducing the nuclear fusion between a heavy target and a projectile of average atomic weight is particularly emphasized. The compound nucleus thus formed must possess maximum sphericity and de-excite by γ emission and possibly α emission. It is indicated how α emission allows the island of stability to be approached when the fusion nuclei are in the Z = 126, N = 184 region. The effects of angular momenta and their implications in limiting the cross sections are discussed. It is shown that the reactions of krypton with uranium and thorium are among the most interesting. Methods of identifying these new nuclei, which are remote from the known elements, are described: observation of the characteristic properties (energy of the fragments, number of neutrons, chemical characteristics), mass determination from momentum measurements, energy measurements, and time-of-flight measurements. It is demonstrated that A and Z can be determined with a mass spectrometer, which can sort out the alkaline elements from the alkaline-earths. (France)

1338 DECAY OF LONG-PERIOD ^{128}Sb AND ^{130}Sb ISOMERS. Kiselev, B. G.; Levkovskii, V. N.; Artem'ev, O. I. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 14: No. 2, 249-52(Aug 1971). (In Russian).

γ and β spectra of the 8.6-hour ^{128}Sb isomer and of 40-min ^{130}Sb isomer were studied using a semiconductor Ge(Li) γ spectrometer and a scintillation β spectrometer. In the ^{128}Sb spectrum γ lines of 314.5(78), 524.5(44), 628.5(31), 636(31), 653.5(16), 742.5(100), 754(100), 812.5(12), 843.8(4.5), 877.1(3.4), 1049(1.5), 1080(1.5), and 1152(1.0) keV were obtained. (Intensities in brackets). The end-point energy of the β spectrum was found to be 2300 ± 100 keV. In the ^{130}Sb γ-ray spectrum the following γ lines, were observed: 184(100); 262(0.5); 331(81); 468(30); 735.3(22); 793.6(100); 841.6(100); 890(4); 940(20); 1090(20) keV. The end-point energy of the β spectrum is found to be 2900 ± 100 keV. The ^{128}Sb decay mode is proposed. (auth)

1339 RATIO OF PRODUCTION CROSS SECTION FOR ISOMER PAIRS OF THE Sb NUCLEI IN (p,n) AND (p,2n) REACTIONS. Skakun, E. A.; Klyucharev, A. P.; Rakivnenko, Yu. N.; Romanii, I. A. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 14: No. 2, 261-8(Aug 1971). (In Russian).

Ratios of the production cross sections for the isomer pairs (σ_m/σ_g) were measured in the following reactions: ^{116}Sn(p,n)^{116m,g}Sb, ^{117}Sn(p,2n)^{116m,g}Sb, ^{118}Sn(p,n)^{118m,g}Sb, ^{119}Sn(p,2n)^{118m,g}Sb, ^{120}Sn(p,n)^{120m,g}Sb, and ^{122}Sn(p,n)^{122m,g}Sb. Theoretical analysis of the isomer ratios for the reactions was carried out using the Vandenbosch–Huizenga method in framework of the Fermi-gas model. The calculations were performed. To agree the theory with the experiment at $I = I_{rb}$ one needs unreasonably high values of the level density parameter: $a \approx 1/3A$. The isomer ratios for pairs ^{116m,g}Sb, ^{118m,g}Sb, ^{120m,g}Sb, produced in the (p,n) reaction are in agreement with the theoretical calculations at $a = 1/8A$ and $I \approx 0{,}5I_{rb}$. For the reactions ^{117}Sn(p,2n)^{116m,g}Sb and ^{119}Sn(p,2n)^{118m,g}Sb a reasonable agreement is observed at the values $I = 0.8I_{rb}$ and $I = 0.7I_{rb}$, respectively. The ratio of the production cross sections in the reaction ^{122}Sn(p,n)^{122m,g}Sb is too high as compared with that from theoretical calculations. (auth)

1340 ANALYSIS OF ANGULAR DISTRIBUTIONS OF NEUTRONS SCATTERED BY URANIUM AT SMALL ANGLES AND NEUTRON POLARIZABILITY. Anikin, G. V.; Kotukhov, I. I. Yadern. Fiz.; 14: No. 2, 269-76(Aug 1971). (In Russian).

The question is considered on the addition of the polarization potential to the optical nuclear potential with a large number of parameters. It is shown that the assumption on the neutron polarizability allows one to describe angular distributions of scattered neutrons considerably better. (auth)

1341 SHELL-MODEL AND β-DECAY CALCULATIONS FOR THE A = 211 ISOBARS. Rao, Dandamudi V.; Gerace, W. J. (Univ. of Massachusetts, Amherst). Nucl. Phys.; A175: No. 2, 405-16 (1971).

Shell-model wave functions and energies are obtained for ^{211}Pb, ^{211}Bi, and ^{211}Po in the basis $[\nu 2g_{9/2}]^n[\pi h_{9/2}]^{3-n}$. In ^{211}Bi the $2f_{7/2}$ proton orbital is also included for the case of paired neutrons. Electromagnetic and β-decay transition rates are calculated and compared with experiment. In particular, the resulting wave function for the first excited state of ^{211}Bi reproduces the log-ft value for β-decay from ^{211}Pb and the angular correlation coefficient A_2, but not the electromagnetic properties. (auth)

1342 γ-RAY SPECTRA OF ^{102}Rh AND ^{102m}Rh AND EXPERIMENTAL STUDY OF THE RATIO ^{102}Rh/^{102m}Rh IN SOURCES PREPARED BY DEUTERON, PHOTON, AND NEUTRON IRRADIATION. Francois, J. P.; Gijbels, R.; Hoste, J. (Ghent Univ.). J. Inorg. Nucl. Chem.; 33: No. 8, 2255-70(Aug 1971).

^{102,102m}Rh sources were produced by the following reactions: ^{103}Rh(n,2n), ^{103}Rh(γ,n), ^{104}Pd(d,α) and Ru(d,xn). The energies and relative intensities of the γ-rays associated with the decay of the 206d and 2.9 yr ^{102}Rh activities were measured with an 18 cm^3 Ge(Li) detector, and the net γ-ray spectra of ^{102}Rh ($t_{1/2}$ = 206d) ^{102m}Rh are shown. The yields of ^{102}Rh and ^{102m}Rh for the different rhodium sources were computed from the γ-ray spectra observed with a Ge(Li) detector of known efficiency. The low-energy region of the γ-ray spectrum of ^{102,102m}Rh was investigated with a Si(Li) detector. (auth)

1343 SPONTANEOUSLY FISSIONING ISOMERS IN ^{237}Pu. Temperley, J. K. (Ballistic Research Labs., Aberdeen Proving Ground, Md.); Morrissey, J. A.; Bacharach, S. L. Nucl. Phys.; A175: No. 2, 433-42(1971).

The properties of two spontaneously fissioning isomers occurring in the nucleus ^{237}Pu are studied. The isomers were produced by the ^{237}Np(d,2n)^{237m}Pu reaction. The half-lives were measured to be 114 ± 12 nsec and 950 ± 300 nsec by using a pulsed-beam technique. Excitation functions for the production of each isomer were obtained for deuteron energies between 8.5 and 14.5 MeV. On the basis of a simple spin-independent evaporation model, the energy dependence of the ratios of the cross sections for production of the two isomers suggests that the longer-lived isomer lies at a higher excitation energy in ^{237}Pu than does the shorter-lived isomer. Alternatively, one is led to assume that spin effects influence the excitation function. The single-fragment kinetic energy distribution for delayed events was determined at a deuteron energy of 13 MeV. The energy distribution obtained indicates a large asymmetry in the corresponding mass distribution. (auth)

1344 $(h_{9/2})^2$ TWO-QUASIPARTICLE ISOMERIC STATE IN ^{202}Po. Hagemann, U.; Neubert, W.; Schulze, W. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A175: No. 2, 428-32(1971).

In ^{202}Po a two-quasi-particle state of $\pi(h_{9/2})^2$ configuration with half-life $T_{1/2}$ = 165 ± 20 nsec and transition energies 443, 571, and

677 keV was found. In ^{204}Po the half-life of the $J = 8^+$ isomeric state was measured as $T_{1/2} = 140 \pm 5$ nsec. (auth)

1345 TRANSITIONS IN ^{146}Gd FOLLOWING THE (α,2n) REACTION ON ^{144}Sm. Spoelstra, B. (Univ. of Zululand, Empangeni, S. Afr.). Nucl. Phys.; A174: No. 1, 63-72(1971).

Targets of ^{144}Sm were bombarded with α-particles of energy from 19.8 to 31.6 MeV. Conversion electron and γ-emission from these targets were studied under bombardment by means of a six-gap β-spectrometer and Ge(Li) detectors. Several transitions observed are interpreted as transitions from excited states in ^{146}Gd, for which previously no experimental data have been published. Evidence is found of the existence of a 2^+ state at 1581 keV, a 0^+ state at 2179 keV, a 4^+ state at 2660 keV and, with less confidence, of states at 2984, 3555, 3754 and 4065 keV. (auth)

1346 PERTURBATIONS OF ALPHA–GAMMA ANGULAR CORRELATIONS IN THE DECAY OF ^{230}U AND ^{226}Th. Hesselink, W. H. A.; van Kampen, M. (Univ. of Technology, Delft, Netherlands). Z. Phys.; 247: No. 2, 161-5(1971).

Perturbations of $\alpha-\gamma$ angular correlations in the decay of ^{230}U and ^{226}Th, involving the 2^+ states in ^{226}Th and ^{222}Ra, have been studied using ^{230}U sources prepared by evaporation of the activity on Al foils, and ^{226}Th sources, prepared by collecting recoil nuclei from a ^{230}U source on Al foils. In vacuum, perturbation coefficients are found to be in agreement with the "hard-core-value" for static magnetic interaction. The perturbations in aluminum are found to be strongly dependent on the method of source preparation. (auth)

1347 CONVERSION ELECTRON SPECTRUM OF ^{196}Pt AFTER NEUTRON CAPTURE. Waldschmidt, M.; Osterman, P. (Univ., Frankfurt am Main). Z. Phys.; 247: No. 2, 153-60 (1971). (In German).

The superconducing conversion electron analyzer SULEIKA has been used to measure the electron spectrum of ^{196}Pt after neutron capture in ^{195}Pt. The experimental arrangement is described. Energies and intensities of 20 K-, 10 L- and 3 M-lines are reported and, using known γ-data as well as K to L ratios, multipolarities are determined. (auth)

1348 LEVELS IN ^{222}Rn. Lourens, W.; Wapstra, A. H. (Univ. of Technology, Delft, Netherlands). Z. Phys.; 247: No. 2, 147-52(1971).

An attempt has been made to observe gamma-rays from the 3^- level of the possible octupole band in ^{222}Rn occurring in the decay of ^{226}Ra. The gamma-ray energies already known in this decay have been measured with increased precision both in singles measurements and in coincidence with the 186-keV ($2^+ \rightarrow 0^+$) transition. (auth)

1349 DIRECTIONAL CORRELATION IN THE β-DECAY OF ^{211}Pb. Rao, Dandamudi V.; Sastry, S. R. (Univ. of Massachusetts, Amherst). Nucl. Phys.; A175: No. 2, 396-404(1971).

The 970-keV β transition in the decay of ^{211}Pb to the $^7/_2^-$ first excited state of ^{211}Bi was investigated by measuring the directional correlation of this β group with the 405-keV cascade γ ray by using a scintillation $\beta-\gamma$ coincidence spectrometer. The directional correlation coefficient A_2 is found to be about -0.03 for β-ray energies above 550 keV. This and other available information indicate the most likely J^π assignment for ^{211}Pb to be $^9/_2^+$. On this basis the directional correlation data were analyzed for β-decay matrix elements by using the formulation of Morita and Morita [Phys. Rev., 109: 2048 (1958)]. It is found that the data are very well explained by the Kotani parameters [Phys. Rev., 114: 795 (1959)] $x = 0.75 \pm 0.15$, $y = 33 \pm 7$, and $z = 1.30 \pm 0.40$. These results are in agreement with expectations based on the CVC theory and shell-model calculations of Rao and Gerace. The ft value for the β transition is also well reproduced by these matrix elements. (auth)

1350 DECAY OF ^{94}Y($T_{1/2}$ = 18.7 min). Cavallini, P.; Andre, S.; Monnand, E.; Schussler, F. (CEN, Grenoble, France. Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A175: No. 2, 363-73(1971). (In French).

The decay of ^{94}Y ($T_{1/2} = 18.7 \pm 0.1$ min) was reinvestigated. The use of a magnetic spectrometer showed the "unique" shape of the β-ray transition to the ground state of ^{94}Zr and confirmed the 2^- spin of this state. The γ rays of ^{94}Zr were studied through the use of Ge(Li) detectors, both in singles and coincidence. Eighteen γ rays were observed and placed in a decay scheme involving eleven excited levels in ^{94}Zr, which are discussed in connection with the results of nuclear reaction studies. (auth)

1351 PARITY MIXING IN ^{203}Tl. Baker, K. D.; Hamilton, W. D. (Univ. of Sussex, Brighton, Eng.). Nucl. Phys.; A175: No. 2, 350-62(1971).

An angular correlation measurement of the asymmetry in γ-ray emission with respect to the β direction following the decay of ^{203}Hg was made. The 279-keV transition in ^{203}Tl is a mixed E2–M1 multipole, the M1 component being 1 forbidden, and it is expected that a parity-violating E1 contribution, if present, might have an amplitude of $\approx 10^{-4}$ with respect to the M1 component. A measuring system with a high degree of inherent symmetry yielded $A_1 = (5.8 \pm 7.9) \times 10^{-5}$, which is consistent with other experimental results. A detailed analysis is presented of possible spurious contributions to the asymmetry due to competing effects and geometrical asymmetries. These are all shown to be negligible in the present work. A measurement was also made of the $\beta-\gamma$ angular correlation; it yielded $A_{22} = (0.9 \pm 2.0) \times 10^{-3}$ and is well supported by recent measurements. (auth)

1352 REGULARITIES OF ISOTOPE PRODUCTION IN MANY-NUCLEON TRANSFER REACTIONS. Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Shamsutdinov, A. O. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 14: No. 1, 54-64(Jul 1971). (In Russian).

Results of experiments are given on the yields of many-nucleon transfer reaction products on Au, Pb, and Bi nuclei exposed to the ^{12}C, ^{22}Ne, and ^{40}Ar ions. Angular distributions of some products of the transfer reaction and the spectra of their kinetic energies are also studied. On the basis of the data obtained some conclusions are made on the many-nucleon transfer reaction mechanism. (auth)

1353 NEUTRON FISSION CROSS SECTION OF ^{249}Bk AND ^{249}Cf. Fomushkin, E. F.; Gutnikova, E. K.; Maslov, A. N.; Novoselov, G. F.; Panin, V. I. Yadern. Fiz.; 14: No. 1, 73-8 (Jul 1971). (In Russian).

By means of dielectric detectors the cross sections and fragment angular anisotropy are measured for neutron fission of ^{249}Bk and ^{249}Cf at several values of the neutron energy and for the fast-neutron reactor energy spectrum. The possible effect of the neutron subshell N = 152 on the fission properties of the isotopes in view is discussed. (auth)

1354 ANGULAR ANISOTROPY AND NUCLEAR FISSION CROSS SECTION WITHIN Z = 73 TO 83 BY 38 MeV α PARTICLES. Kuvatov, K. G.; Okolovich, V. N.; Smirina, L. A.; (and others) (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 14: No. 1, 79-87(Jul 1971). (In Russian).

Angular distributions of fragments and cross sections of the fission of 18 isotopes from ^{181}Ta up to ^{209}Bi by 38-MeV α particles were measured using glass detectors. The experimental data are analyzed in terms of the statistical theory. Information was obtained on the effective moments of inertia in the transition state and on the shell structure of the level density of equilibrium nuclei at excitations ~30 MeV. (auth)

Nuclear Theory

Refer also to abstracts 654, 990, 1173, and 1230.

1355 (CEA-N-1467) PROGRAMS FOR COMPUTING THE COEFFICIENTS OF CLEBSCH–GORDAN (AND 3-JM), OF RACAH (AND 6-J) 9-J, Z' (COMPOUND NUCLEUS), AND Z' (STATISTICAL MODEL). Martinot, Michel; Gautier, Michele (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). 7 Jul 1971. 70p. (In French). Dep. NTIS (U. S. Sales Only).

The programs used for the computation of the most conventional recoupling coefficients have been collected. A list of specifications is given for each of them which defines the limits and the conditions for their use. (auth) (France)

1356 (CONF-690217) FOURTH WINTER SCHOOL ON NUCLEAR THEORY AND HIGH-ENERGY PHYSICS, LENINGRAD, FEBRUARY 5–17, 1969. PART I. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1969. 276p. (In Russian).

There were 11 lectures included, two of which were abstracted previously in NSA. For abstracts of these lectures see abstract numbers 24:10700 and 24:22197. Separate abstracts were prepared for nine lectures. (J.F.P.)

For abstracts of individual lectures see: 1024, 1029, 1047, 1244, and 1357–1361.

1357 (CONF-690217–, pp 34-72) PHENOMENOLOGICAL PROBLEMS OF THE NUCLEAR REACTION THEORY. Kolybasov, V. M. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

Information obtained only on the basis of the conservation laws of energy, momentum, angular momentum, etc., allows one to determine the range of kinematic variables best suited to study dynamic effects. For this reason, the physical areas of reactions yielding 3 particles were investigated, together with the distribution of momentum spectra and angular correlations. The amplitudes of such multiparticle reactions involving interaction of particles with spins were analyzed on the basis of invariant form factors. The study was limited in general to nonrelativistic cases, but a few noncomplicated relativistic cases were also considered. (TTT)

1358 (CONF-690217–, pp 73-100) CLUSTERED THRESHOLD STATES IN NUCLEI. Baz, A. I. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

The threshold states theoretically predicted previously are related to a 2-particle splitting of the nucleus: $B \rightarrow a_i + x_i$, (i = 1,2,3...). These states have an abnormally large radius, a clustered structure and consists of threshold particles, a_i and x_i. The actual existence of such states has been confirmed experimentally during the last few years. Currently available knowledge concerning these particles is reviewed, outlining first the theory and fundamental properties and indicating the conditions required for their existence. Classification of threshold states is then indicated, predicting the potential existence of complete systems of clustered bands. The available experimental data which demonstrate the existence of high excitation energy clustered states in light nuclei and the theoretical interpretation of this data are summarized. Clustered threshold states may exist near the splitting up threshold of intermediate nuclei at any pair of particles; thus, the ^{20}Ne nucleus may be split into ($n + {}^{19}$Ne), ($p + {}^{19}$F); ($d + {}^{18}$F), ($\alpha + {}^{16}$O), (^{8}Be + ^{12}C), each of which may have associated clustered states. In the case of T, ^{3}He, ^{4}He, ^{6}Li, ^{7}Li, and other clusters no simple laws concerning clustered state have yet been derived. (TTT)

1359 (CONF-690217–, pp 101-17) LEVEL DENSITIES AND STRENGTH FUNCTIONS OF NUCLEI NEAR THE NEUTRON BOND ENERGY. Pikel'ner, L. B. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

Studies on the neutron spectroscopy of the nonfissionable nuclei carried out at the Joint Institute for Nuclear Research were reviewed. Use of the microtron yielding short pulses of γ-bremsstrahlung made it possible to improve considerably the resolution of the neutron spectrometer. The resolution of the work reached 3 nsec/m for the passage of the radiation and 12 nsec/m for radiative capture; the latter was measured by means of liquid scintillation detectors. Most of the work involved measurement of the neutron cross section of rare-earth elements and nuclei with a mass number between 70 and 80, using enriched isotropic species. More than 200 level parameters were measured for the stable germanium and selenium isotopes. Experimental data on strength functions on the nuclei were found to agree with values derived from the optical model but further work is still needed. The goals of future research should be aimed at the achievement of high precision and derivation of strength functions in a wider energy range; at the same time the spin relation of the strength function should be clarified. The optical model cannot be used for mass numbers in the 100 to 120 and 155 to 177 range. (TTT)

1360 (CONF-690217-, pp 118-37) EFFECTS OF THE HYPERFINE STRUCTURE IN μ CAPTURE. Bukhvostov, A. P.; Popov, N. P. (In Russian).

The role of meson processes in the spin-induced μ-capture reactions was examined, considering specifically the effect of the hyperfine spallation of the K shell and the possible transitions between its sublevels. The μ meson falling on the external orbit of a mesic atom undergoes transition at the K shell where its lifetime is determined both by the probability of its decay and the μ capture. The conversion transitions within the hyperfine doublet of the K shell were studied, determining the true dependence of the μ capture, the polarization of μ mesons and the correlation of particles which participate in the μ-meson reactions and thereby determine the characteristics of nuclear levels, determining also the weak interaction constants in μ capture. Although a large volume of experimental data is available under capture of μ mesons in hydrogen and complex nuclei, it is not yet possible to identify all the μ capture constants with the desired accuracy. (TTT)

1361 (CONF-690217–, pp 238-49) FISSION NEUTRONS. Pik-Pichak, G. A. (In Russian).

From fourth winter seminar on nuclear theory and high-energy; Leningrad, USSR (5 Feb 1969).

Fission of heavy elements releases about 200 MeV of energy, of which about 10% is spent in the release of neutron and γ quanta. The mechanism involved in the release of prompt neutrons in the fission process was examined. The angular distribution of neutrons was found to exhibit a maximum in the direction of the motion of the fission fragments. Evaporations of neutrons from the fragments yield information about their nuclei because the fragments have neutron-access nuclear structure. Determination of the energy distribution of fission neutrons at various angles with respect to the motion of the fragments is of special interest for study of the structure. The number of neutrons ranges from 2.4 for the fission of ^{235}U by thermal neutrons to 3.8 for the spontaneous fission of ^{252}Cf. The indeterminate nature of the neutron bond energy does not allow one to determine the original mean energy of excitation of fragments on the basis of the emitted neutrons; therefore, in order to estimate the heat capacity of the average density of 1-particles levels at the Fermi boundary, rough calculations must be used, for example, by taking advantage of the correlation between the temperature and the excitation energy. (TTT)

1362 (CONF-710301–(Vol.1), pp 154-78) FAST NEUTRON CROSS SECTIONS: THEORY AND EXPERIMENT. Moldauer, P. A.; Smith, A. B. (Argonne National Lab., Ill.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The theoretical and experimental tools used for the determination and evaluation of fast neutron cross sections are reviewed, with particular emphasis on the coordination of experiment and theory. The optical model is related to experimental information on average total neutron cross sections and strength functions. Statistical model assumptions are discussed in the light of resonance data. The consequences of these models for the prediction of averages and fine structures of reaction cross sections are developed and the results of numerical predictions are presented. The strengths and weaknesses of the theoretical and the experimental approaches are discussed and their cooperative uses are explored. (auth)

1363 (CONF-710301–(Vol.1), pp 184-90) OPTICAL MODEL ANALYSES OF EXPERIMENTAL FAST NEUTRON ELASTIC SCATTERING DATA. Holmqvist, B.; Wiedling, T. (Aktiebolaget Atomenergi, Studsvik (Sweden)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Analytical descriptions of fast elastic neutron scattering cross sections and generalized optical model parameter sets are of great value in connection to reactor shielding calculations as well as, for instance, for predictions of the nuclear properties of fission products. Such descriptions and generalizations have previously been presented outgoing from scattered (and rather uncertain) experimental information, contrary to the present evaluation founded on a relatively large set of neutron data. The neutron elastic scattering data collected for a number of elements and at several neutron energies have been used in an attempt to get generalized analytical expressions for some parameters of the spherical optical model potential, i.e., the real and imaginary potential depths and the radii of these potentials. Even if the experimental information is comparatively extensive it is still somewhat too meager in some atomic mass ranges to be used for such a purpose. (auth)

1364 (CONF-710301–(Vol.1), pp 386-92) SYSTEMATIC STUDY OF AVERAGE PARAMETERS OF NEUTRON RESONANCES. Mughabghab, S. F. (Brookhaven National Lab., Upton, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Because of their importance in nuclear models and reactor calculations, the average parameters of neutron resonances related to S- and P-wave neutron strength functions, level spacings, radiation widths, reduced neutron widths, and scattering radii have been compiled and recommended values made. In addition some of these parameters are compared with existing nuclear model calculations and the systematic properties of these average parameters will be presented. (auth)

1365 (CONF-710301–(Vol.2), pp 876-81) GAMMA-RAY SPECTRA FROM (n,γ) REACTIONS IN THE HIGH NEUTRON ENERGY RANGE. Longo, G.; Saporetti, F. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The use of theoretical estimates is required for shielding design purposes to fill the gaps in the experimental data on gamma-ray spectra from (n,γ) reactions in the high neutron energy range. A model, which includes both direct and collective processes as well

as their interference, is used to carry out systematic calculations. The shape and magnitude of experimental spectra are satisfactorily reproduced. (auth)

1366 (GEAP-13704) ENDRUN-II: A COMPUTER CODE TO GENERATE A GENERALIZED MULTIGROUP DATA FILE FROM ENDF/B. Hutchins, B. A.; Cowan, C. L.; Kelley, M. D.; Turner, J. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Mar 1971. Contract AT(04-3)-189. 137p. Dep. NTIS.

The program ENDRUN II written in FORTRAN IV is used to calculate multigroup constants from energy-dependent microscopic cross sections, resonance parameters and inelastic level data input in the Evaluated Nuclear Data File (ENDF/B) formats. This program requires 52K memory on the GE 635 including a 10K overlap with leading routines. (J.F.P.)

1367 (ITF-71-54-P) POLARIZATION OF THE NUCLEONS APPEARING FROM THE ELECTRON DISINTEGRATION OF LIGHT NUCLEI. Tartakovskii, V. K. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

General formulas for polarization of the nucleons knocked out of atomic nuclei are derived for the case of nonelastic scattering of fast electrons. A numerical estimate of the polarization is made, and it is shown that nucleons can be considerably polarized both on account of the spin-orbital interaction of the outgoing nucleon with the nucleus and on account of the nucleon-electron electromagnetic interaction. Polarization of the nucleons resulting from the nuclear disintegration is strongly dependent on the nuclear potential that interferes with the nucleon waves in the finite state. (auth)

1368 SOME REMARKS ABOUT THE TIME-DEPENDENT DESCRIPTION OF COLLISIONS. Olkhovskii, V. S. (Univ., Milan. Univ., Turin). Energ. Nucl. (Milan); 18: No. 9, 478-81 (Sep 1971).

The cases in which it is possible to use the on-shell transition matrix instead of the strict evolution operator in the time-dependent collision evolution are investigated. Further, the generalized definition of the effective duration for any partial collision process is given. (auth)

1369 PROPERTIES OF BOUND STATES IN THREE-BODY PROBLEM WITH SEPARABLE POTENTIALS. Kukulin, V. I. (Moscow State Univ.). Czech. J. Phys.; 21: No. 9, 923-9 (1971).

A system of three identical bosons with the pair separable S-interaction is considered. The monotonic (Yamaguchi potential) and oscillating pair potentials for the three-alpha model of ^{12}C have been investigated. In the case of the Yamaguchi potential many excited states (second, third, etc.) have been found. (auth)

1370 INTENSITY RULES FOR PARTIAL WIDTHS OF DEFORMED ANALOG RESONANCES. Kerman, A. K.; de Toledo Piza, A. F. R. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Ann. Phys. (N. Y.); 66: No. 1, 351-65(Jul 1971).

Intensity rules for the escape widths of isobaric analogs of rotational states in deformed nuclei are obtained. These rules correctly take into account inelastic scattering to other states within the rotational band in the target nucleus. The simplest results are obtained in the limit of vanishing rotational energy (adiabatic approximation). First-order corrections in the inverse moment of inertia are also given. (auth)

1371 FORMAL THEORY OF FINITE NUCLEAR SYSTEMS. Klein, Abraham (Univ. of Pennsylvania, Philadelphia). Ann. Phys. (N. Y.); 66: No. 1, 390-404(Jul 1971).

A new formal derivation of the shell model is presented which is equally applicable at closed shells or far removed from them. The development is framed within a theoretically based generalization of the intermediate coupling equations of de Shalit [Phys. Rev., 122: 1539(1960)], although arguments are also given for referring these back to an effective Hamiltonian. (auth)

1372 COULOMB EXCITATION OF PARTICLE-UNSTABLE STATES. Weidenmueller, Hans A. (Univ., Heidelberg. Max-Planck-Institut fuer Kernphysik, Heidelberg); Winther, Aage. Ann. Phys. (N. Y.); 66: No. 1, 218-47(Jul 1971).

In the Coulomb excitation of decaying states, it is important to take into account the energy dependence of the decay widths, i.e., penetration factors and threshold effects. This can be done by using methods developed in the framework of the shell-model approach to nuclear reactions. In order to display the energy dependence of the widths, it is convenient to Fourier-transform the time-dependent equations of motion describing Coulomb excitation. The physical content of the resulting equations is discussed by considering several limiting cases. The following characteristic times play a central role: the lifetime, $\hbar/\Gamma$, of a resonance; the collision time, T, of the Coulomb excitation process; the transition time, $\hbar/|E-E_0|$, connected with the excitation energy $E-E_0$; and the response time, τ, related to the time delay caused by virtual transitions to the various channels. (auth)

1373 PIONS IN NUCLEAR MATTER: AN APPROACH TO THE PION-NUCLEUS OPTICAL POTENTIAL. Dover, Carl B. (Univ., Heidelberg. Max-Planck-Institut fuer Kernphysik, Heidelberg); Huefner, Joerg; Lemmer, R. H. Ann. Phys. (N. Y.); 66: No. 1, 248-92(Jul 1971).

The optical potential for pions propagating in nuclear matter is investigated from a many-body point of view. An exact expression for the optical potential is obtained in terms of the nuclear matter density–density correlation function. Explicit calculations of the pion self-energy, which is simply related to the optical potential, are performed via an expansion in the nuclear density, n_0. The familiar result of multiple scattering theory, $4\pi n_0 f_0$, where f_0 is the pion–nucleon scattering length, is recovered in lowest order. The terms quadratic in n_0 account for the long-range Pauli correlation corrections to the pion–nucleon scattering process (quenching), as well as dispersion and absorption contributions coming from nucleon–nucleon collisions in the medium. The latter terms are proportional to off-shell nucleon–nucleon scattering amplitudes. This treatment is compared and contrasted with that of Ericson and Ericson. In particular, the approximations in the nuclear many-body problem are established which lead to their form of s-wave potential that includes long-range correlation effects as well as their p-wave potential that has a nonlinear density dependence (the Lorentz–Lorentz effect). Estimates of the dispersion and absorption terms are made using two simple models to describe interacting nuclear matter. (auth)

1374 RESONANT ELASTIC SCATTERING OF PROTONS FROM ANALOG AND COMPOUND STATES. Fallieros, S. (Brown Univ., Providence); Brown, G. E. Contract AT(30-1)-4032. Ann. Phys. (N. Y.); 66: No. 1, 293-310(Jul 1971).

A general derivation of the amplitude for elastic scattering in the presence of one analog state and many compound (T-lower) states is given. The form of the amplitude is derived in a rather general scattering formalism, by using unitarity and invariance under time reversal. Within this formalism, the assumptions necessary to make the transmission coefficient $P_A(\epsilon)$ vanish at some energy are stated. An additional assumption is necessary if it is to vanish at the unperturbed energy ϵ_A of the analog, as in Robson's model [Phys. Rev., B137: 535(1965)]. (auth)

1375 HIGH-ENERGY SCATTERING BY NUCLEI. II. Feshbach, Herman; Gal, Avraham; Huefner, Joerg (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Ann. Phys. (N. Y.); 66: No. 1, 20-59(Jul 1971).

A coupled-equation description of the scattering of fast particles is formulated. For elastic scattering two coupled channels are employed. One wavefunction describes the elastic channel. The other is an "average" wavefunction that takes into account the collisions that remove the incident particles from the elastic channel. Explicit formulas are given for the coupling and diagonal potentials as obtained from the Kerman, McManus, and Thaler multiple scattering theory [Ann. Phys. (N. Y.), 8: 551 (1959)], which includes the effects of single and double scattering in the nonlocal optical potential. The properties of the target nucleus involved are its density and pair correlation function. These are described in terms of intrinsic coordinates, the relation to model wavefunctions being briefly discussed. Three kinds of correlations are considered: the center-of-mass correlation required of the target nucleons in order that the target recoil as a unit, the exclusion principle or Pauli correlation, and the short-range dynamical correlations. The coupling potential is directly related to the correlation function, vanishing if the correlation function vanishes. Numerical calculations are performed for protons of 1.69 GeV/c momentum incident on ^4He and ^{16}O. It is found that the Pauli correlation has little effect, and that the center-of-mass correlation is the dominant correlation effect for the ^4He target but is not important for ^{16}O. The effect of the short-range correlation is measured by the parameter $(r_c/R)/(1+2r_v^2/r_c^2)$, where r_c is the correlation length; R, the nuclear radius; r_v, the nuclear "force range." In the heavier nuclei, the effect of short-range correlations is proportional to this parameter; in ^4He, because of interference with the center-of-mass correlation terms, the effect is proportional to its square root. Short-range correlations are thus more difficult to observe for heavier nuclei when their range is small compared to the ranges of nuclear forces. Absence of required nucleon–nucleon

data prevents a definitive statement with respect to the presence of short range correlations. However, the present nucleon–nucleon and proton–^{4}He data are not inconsistent with the presence of a repulsive short-range correlation. (auth)

1376 ROTON MODEL OF QUARTETS IN NUCLEI. Arima, Akito; Gillet, Vincent (CEN de Saclay, Gif-sur-Yvette, France). Ann. Phys. (N. Y.); 66: No. 1, 117-36(Jul 1971).

A simple approximation of the dynamics of proton–neutron systems is constructed from the experimental evidence of quasi-independent two-proton–two-neutron structures in nuclei. These strongly self-bound structures have limited angular momenta components, and their mutual weak correlations are responsible for deformations and rotations. A schematic calculation is discussed. (auth)

1377 DISTRIBUTION METHODS FOR NUCLEAR ENERGIES, LEVEL DENSITIES, AND EXCITATION STRENGTHS. Chang, F. S.; French, J. B.; Thio, T. H. (Univ. of Rochester, N. Y.). Ann. Phys. (N. Y.); 66: No. 1, 137-88(Jul 1971).

The centroid energies and widths for configurations, both with and without a specification of isospin, are given in compact forms in which the various terms have a clear physical significance. The forms are derived by use of elementary unitary-group methods, which lead to an orthogonal symmetry decomposition of the Hamiltonian, in which Hartree–Fock-like terms representing the induced single-particle energies and other related quantities enter in a natural way. Appropriate measures for the various terms are given and discussed. The same method is applicable to the more complicated operators encountered when dealing with excitation strengths of various kinds. Some applications are given to determining ground-state energies, orbit occupancies, and low-lying spectra for complicated systems, and comparisons made with shell-model calculations and with experiment. An account, with some elementary applications, is given of a distribution theory of level densities that takes into consideration the shell-model structures and residual interactions; to specify the densities for fixed angular momentum, the configuration distributions are used to derive the energy variation of the J_z^2 and J_z^4 averages, the first of these fixing the "spin cut-off factor", $\sigma(J)$, and the second verifying the accuracy of the Gaussian form commonly used. Finally, an introductory account is given of the distributions of single-particle transfer and electromagnetic-transition strengths in large shell-model spaces. (auth)

1378 FISIUNEA NUCLEARA IZOMERA. (Isomeric Nuclear Fission). Vilcov, N. Bucharest; Editura Academiei Republicii Socialiste Romania (1971). 172p.

Isomeric nuclear fission is encountered in case of elements heavier than protactinium. It has been discovered accidently in 1961 at Dubna by a research group lead by G. N. Flerov during the study of the effects of the bombardment of ^{238}U with ^{22}Ne ions. Study of isomeric fission yields valuable information about the structure of the potential barrier of the fissioning nucleus. The first portion of the book is devoted to a review of the fundamental concepts of nuclear reaction mechanisms in heavy nuclei with chapters on the statistical theory of nuclear reactions, formation of compound nuclei, the optical model, and direct interactions. The isomeric fission itself is discussed in the second part of the book, in which recoil, pulsed-beam, and in-flight fission methods are reviewed. This is followed by a description of competing reactions in the production of spontaneously fissionable isomers, and of the spectrometric properties of isomeric states. The importance of the kinetic moment is clarified by outlining theoretical models for spontaneously fissionable isotopes. Separate chapters are devoted to the discussion of isomeric states at high deformation and subbarrier induced fissions. Studies in progress and anticipated new lines of research are summarized by describing spontaneously fissionable isotopes with very short half-lives and measurement of the spin of these isomers. (TTT)

1379 EINFUEHRUNG IN DIE PHYSIK DES ATOMKERNS. (Introduction to Nuclear Physics). Pose, Heinz. Berlin; VEB Deutscher Verlag der Wissenschaften (1971). 240p. 29,80 M.

The text is based on lectures given at the Technical University, Dresden. The emphasis is on a reasonably understandable presentation of the material rather than comprehensive coverage. Subjects covered are basic nuclear structure, radioactive decay, detection of charged particles, transmission through matter, collision processes, production of high-energy particles, neutrons, conservation laws, the nucleon–nucleon interaction, nuclear reactions, reactions with heavy nuclei, nuclear models, energy production through nuclear reactions, and elementary particles. The appendix treats relativistic relations, solutions of the Schroedinger equation, calculation of neutron range, polarization of nucleons, cross sections of inverse reactions, and relativistic velocities of particles in cyclotrons. (H.B.G.)

1380 POLNOE SOBRANIE NAUCHNYKH TRUDOV. TOM II. YADERNAYA FIZIKA. KNIGA 2. VZAIMODEISTVIE IZLUCHENII S VESHCHESTVOM. (Complete Collection of Scientific Works. Volume II. Nuclear Physics. Book 2. Interaction of Radiation with Matter). Starodubtsev, S. V. Tashkent; Izdatel'stvo FAN Uzbekskoi SSR (1970). 380p.

The work consists of three separate monographs. (I) The passage of heavy charged particles through matter is discussed: elastic collisions, nuclear reactions as a result of excitation, energy losses in inelastic collisions and other phenomena, and associated topics are treated. (520 references) (II) Beta-decay problems are reviewed; these include beta-transition probability, selection rules, spectra and forbidden transitions, and nuclear shell models. (56 references) (III) Atom recoil during beta conversion is considered, with discussion of R spectra, external charge in recoiling atoms, conservation law, beta–R correlations during decay of ^{6}He, ^{32}P, and ^{19}Ne, and beta decay of free neutrons. (71 references) (K.S.W.)

1381 ASYMPTOTIC JOST FUNCTIONS AND S MATRICES FOR LARGE COMPLEX ANGULAR MOMENTA IN THE CASE OF A NUCLEAR-COULOMB POTENTIAL. Poplavskii, I. V. (Odessa Engineering-Construction Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 23-30(1970). (In Russian).

With the aid of the quasi-classical WKB method, the asymptotic form of the Jost functions and the S-matrices of the Schroedinger equation near $\lambda \to \infty$ in the region Re $\lambda > 0$ and for fixed values of the energy are determined for the case of the nuclear Coulomb potential. The generalized Yukawa potential is considered for the nuclear potential. It is shown that the Jost functions and S-matrix in the case of the nuclear Coulomb potential for large complex angular momenta behave as the Jost functions and the S-matrix for a Coulomb potential. (tr-auth)

1382 NUCLEAR CENTRE-OF-MASS CO-ORDINATE IN THE BLOCH–HOROWITZ THEORY. Palumbo, F. (CNEN, Rome. Joint Inst. for Nuclear Research, Dubna, USSR). Lett. Nuovo Cim.; 2: No. 9, 453-8(28 Aug 1971).

A simple method is presented for obtaining factorized eigenfunctions in the framework of the Block-Horowitz theory using a nonfactorized basis. (J.W.R.)

1383 NEUTRON STAR MATTER. Baym, Gordon; Bethe, Hans A.; Pethick, Christopher J. (NORDITA, Copenhagen). Nucl. Phys.; A175: No. 2, 225-71(1971).

The matter in neutron stars is essentially in its ground state and ranges in density up to and beyond 3×10^{14} g/cm^3, the density of nuclear matter. The constitution of the ground state of matter and its equation of state are determined in the regime from 4.3×10^{11} g/cm^3, where free neutrons begin to "drip" out of the nuclei, up to densities $\approx 5 \times 10^{14}$ g/cm^3, where standard nuclear-matter theory is still reliable. The energy of nuclei in the free neutron regime is described by a compressible liquid-drop model designed to take into account three important features: as the density increases, the bulk nuclear matter inside the nuclei and the pure neutron gas outside the nuclei become more and more alike; the presence of the neutron gas reduces the nuclear surface energy; and the Coulomb interaction between nuclei, which keeps the nuclei in a lattice, becomes significant as the spacing between nuclei becomes comparable to the nuclear radius. Nuclei survive in the matter up to a density $\sim 2.4 \times 10^{14}$ g/cm^3; below this point no tendency for the protons to leave the nuclei is found. The transition between the phase with nuclei and the liquid phase at higher densities occurs as follows. The nuclei grow in size until they begin to touch; the remaining density inhomogeneity smooths out with increasing density until it disappears at about 3×10^{14} g/cm^3 in a first-order transition. It is shown that the uniform liquid is unstable against density fluctuations below this density; the wavelength of the most unstable density fluctuation is close to the limiting lattice constant in the nuclear phase. (auth)

1384 HARTREE FOCK CONTRIBUTIONS TO THE EFFECTIVE CHARGE AND INTERACTION IN THE sd SHELL. Ellis, P. J. (Nuclear Physics Lab., Oxford); Mavromatis, H. A. Nucl. Phys.; A175: No. 2, 309-36(1971).

The second-order perturbation-theory diagrams for the effective charge that contain HF insertions are evaluated —they are sizable and negative for neutrons, and quite state-dependent for protons. The total second-order result is generally about $-\frac{1}{3}$ of the first-order value; this result suggests that the effective charge does not smoothly converge to the required value in terms of the number of interactions. As concerns the effective-interaction expansion ordered according to the number of G matrices, the inclusion of the HF diagrams is not expected to improve the poor convergence. The bare and first-order perturbation theory diagrams are evaluated in a HF basis for both the effective charge

and interaction. The bare effective-charge diagram is enhanced for protons compared to the oscillator result. For the bare interaction the levels are significantly less bound when the HF basis is used, particularly when the $s_{\frac{1}{2}}^2$ configuration is involved. The first-order perturbation corrections are much reduced in a HF basis compared to the oscillator results —the core-polarization diagram is reduced by factors of roughly 2 and 5 for the effective charge and interaction, respectively. In all cases the diagrams containing HF insertions give nonnegligible contributions that are as important as those from the other diagrams. (auth)

1385 CALCULATION OF D_Λ IN THE PHASE-SHIFT APPROXIMATION. Borodziuk, S. (Military Academy of Tech., Warsaw); Dabrowski, J. Acta Phys. Pol.; B2: No. 5, 615-21 (Sep–Oct 1971).

The accuracy of the phase-shift approximation in calculating the well depth of a Λ particle in nuclear matter, D_Λ, is investigated. A model case of a simple Λ–N potential is considered. The value of D_Λ calculated in the phase-shift approximation is about 10 MeV higher than the value obtained by the complete K-matrix method. This indicates that the phase-shift approximation is too rough for application in the D_Λ problem. (auth)

1386 SEPARATION METHOD AND Λ-PARTICLE BINDING IN NUCLEAR MATTER. Skladanowski, Z. (Univ., Warsaw). Acta Phys. Pol.; B2: No. 5, 645-55(Sep-Oct 1971).

The binding energy of a Λ particle in nuclear matter, $B_\Lambda(\infty)$, is calculated with the help of the modified Moszkowski–Scott separation method. This procedure permits systematic expansion of the effective Λ–nucleon interaction in terms of G_s, the reaction operator for free particles caused by the short-range part of the potential alone. The form of the series is discussed. The contribution of all first- and second-order terms to the binding energy is calculated numerically with two central ΛN potentials. The rearrangement energy is taken into account. The calculated $B_\Lambda(\infty)$ is compared with the empirical value of $B_\Lambda(\infty)$. Possible ways of reducing the calculated value of $B_\Lambda(\infty)$ are discussed. (auth)

1387 PROBLEMY FIZIKI ELEMENTARNYKH CHASTITS I ATOMNOGO YADRA. (ECHAYA). TOM 1, VYPUSK 2. (Problems of Elementary Particle and Atomic Nucleus Physics. (Particles and Nucleus). Vol. 1, Part 2). Bogolyubov, N. N. (ed.). Moscow; Atomizdat (1971). 584p.

Separate abstracts were prepared for each of the 6 articles included. (J.W.R.)

For abstracts of individual papers see: 809, 1018, 1022, 1128, 1388, and 1389.

1388 SELF-CONSISTENT FIELD METHOD IN NUCLEAR THEORY. Dzholos, R. V.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 365-90 of Problemy Fiziki Elementarnykh Chastits i Atomnogo Yadra. Tom 1, Vypusk 2. /Bogolyubov, N. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The self-consistent field method in the Bogoliubov formulation is presented. The equations for the effective fields of the finite Fermi system theory and the secular equations of the model with pairing and multipole forces are derived from the basic equations of the self-consistent field method. (auth)

1389 TRI-QUASI-PARTICLE STATE IN DEFORMED NUCLEI IN THE REGION $150 < A < 190$. Gromov, K. Ya.; Usmanova, Z. A.; Fedotov, S. I.; Shtruchyi, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 525-46 of Problemy Fiziki Elementarnykh Chastits i Atomnogo Yadra. Tom 1, Vypusk 2./Bogolyubov, N. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The splitting and deexcitation of three quasiparticle states and the possibilities of their experimental observation and investigation in deformed nuclei in the region of $150 < A < 190$ are considered. The splitting energies of experimentally observed three-quasiparticle states, the limit values of the parameters W and α determining the interaction force and the part of the spin forces in common pairing forces, respectively, have been calculated. As is shown by the analysis of the experimental results, the deexcitation of three quasiparticle levels to the one quasiparticle states which is F-forbidden in the model of independent quasiparticles could be explained on the basis of a simple model. (auth)

1390 NUCLEAR PHYSICS STUDIES WITH MESONS. Backenstoss, G. (Univ., Karlsruhe, Ger. CERN, Geneva). pp 171-203 of Plenarvortraege. Stuttgart; B. G. Teubner (1969). (In German).

From thirty-fourth physicists conference; Salzburg, Austria (29 Sep 1969). See CONF-690975.

Reviewed are the effects of high-energy particles, especially of mesons, on nuclei with respect to obtaining information about nuclear structure. Treated are: high energies and impulses of test particles, and negative particles with various properties. Subsequently, electrons and nuclear subparticles are surveyed in regard to distribution of electric charge, magnetic moments, and isomery effects. Special emphasis is focused on test particles consisting of π mesons and K-mesons. (H.B.G.)

1391 FUNDAMENTALS OF THE STATISTICAL THEORY OF NUCLEI. Gombas, P. (Univ., Budapest. Forschungsgruppe fuer Theoretische Physik, Budapest); Kisdi, D. Acta Phys. Acad. Sci. Hung.; 29: No. 2-3, 267-78(1970). (In German).

The kinetic energy of nucleons, electrostatic interaction between protons, and internuclear forces are treated mathematically by means of the statistical theory of the nucleus. The interaction energies resulting from internuclear forces are calculated. An expression for the energy of nuclei is formulated, and methods for calculating the energy minimum are outlined. (H.B.G.)

1392 NONPERTURBATIVE STUDY OF THE ISOBARIC MULTIPLET MASS EQUATION. Lacy, C. E. (Univ. of Washington, Seattle). Ann. Phys. (N. Y.); 65: No. 1-2, 87-124(15 Jun 1971).

An investigation of the isobaric multiplet mass equation (IMME) is carried out, in which the Coulomb interaction is not treated by perturbation theory but is included exactly in a model Hamiltonian. An estimate is made of the leading nonperturbative correction to the usual quadratic IMME, and is compared with results from recent experiments. Two complementary models are developed, in both of which the Coulomb interaction is included exactly. The first is a simple one-particle model that uses a realistic average central nuclear potential, but does not include antisymmetrization effects or residual interactions between valence nucleons. This model allows one to study the A- or Z-dependence of the correction term and determine its order of magnitude. The second model consists of a closed, inert core plus valence nucleons interacting with each other via two-body potentials. This model allows us to study the effect of those features which were ignored in the simple model, but at the cost of introducing the unrealistic harmonic oscillator potential. The results for nuclei of mass number A = 19 confirm the conclusion from the first model that the correction term is of order α rather than $Z\alpha$, where α is the fine structure constant. Charge-dependent effects other than the Coulomb interaction are also studied. It is shown that, in second-order perturbation theory, only the valence nucleons contribute to deviations from the quadratic form of the IMME. (auth)

1393 MULTICHANNEL ND^{-1} APPROACH TO NUCLEAR REACTIONS AMONGST LIGHT NUCLEI. I. GENERAL THEORY. Rinat, A. S. (Weizmann Inst. of Science, Rehovot, Israel); Stingl, M. Ann. Phys. (N. Y.); 65: No. 1-2, 141-80(15 Jun 1971).

The amplitudes for reactions between any two clusters with a total number of particles N are considered. Assuming simple analytic structure for partial-wave amplitudes, one may write down ND^{-1} equations embodying those properties. Those equations describe a channel coupling that preserves two-cluster unitarity. Three-cluster unitarity is treated approximately while fragmentation into more than three clusters is neglected altogether. Driving terms of, in general, longest range are constructed from one-cluster exchange amplitudes with dressed vertex functions. In some cases it may be necessary to include repetitions of the same (triangular graphs) when these exchanges turn out to have ranges comparable to one-cluster exchanges. Amplitudes for the latter can be given for the most general spin configuration; this does away completely with the geometry of channel coupling. The dynamics then resides in the vertex functions, and methods to derive those functions from nuclear models or from scattering data are discussed. It is further shown that the antisymmetrization problem can be solved whatever the reaction will be. A summary of the program, a listing of the obtainable information, and a comparison with other dispersion approaches and existing reaction theories are given. (auth) (76 references)

1394 FORMAL GENERALIZATION OF THE NUCLEAR SHELL-MODEL APPROACH TO REACTIONS FOR TWO PARTICLES IN THE CONTINUUM. Agassi, Dan (Weizmann Inst. of Science, Rehovot, Israel). Ann. Phys. (N. Y.); 65: No. 1-2, 212-26(15 Jun 1971).

The so-called shell-model theory of nuclear reactions is formally generalized to include, in particular, the stripping and pick-up reactions. By the same token, any reaction with no more than two fragments can be included. The final equations are a set of coupled single-variable integral equations. (auth)

1395 DWBA FOR STRIPPING IN THE SHELL-MODEL APPROACH TO REACTIONS. Agassi, Dan (Weizmann Inst. of Science, Rehovot, Israel). Ann. Phys. (N. Y.); 65: No. 1-2, 227-48(15 Jun 1971).

The DWBA form for the energy-averaged stripping amplitude

is derived in the framework of the shell-model approach to reactions. This derivation generalizes, for a rearrangement process, a previous work of Mahaux and Weidenmuller which concerns nucleon–nucleus scattering. The present derivation follows a similar line of argumentation. The required statistical assumptions and optical potentials are stated. Antisymmetry is included in the discussion. (auth)

1396 OPTICAL POTENTIAL FOR THE ELASTIC HEAVY ION SCATTERING. Fliessbach, Torsten (Technische Univ., Munich). Z. Phys.; 247: No. 2, 117-26(1971).

For the elastic scattering of heavy ions a microscopic model is developed which uses shell model wave functions which are localized at a certain distance both in coordinate and momentum space. The antisymmetrization is treated exactly. Using oscillator functions and the Brink-Boeker force the energy dependent real part of the optical potential for $O_{16}-O_{16}$ scattering is numerically determined. The results are compared with the analysis of experiments. (auth)

1397 NUCLEAR ANALYSIS OF BLOCKING EXPERIMENTS. Malaguti, F.; Uguzzoni, A.; Verondini, E. (Univ., Bologna). Lett. Nuovo Cim.; 2: No. 13, 629-34(25 Sep 1971).

A method for the extraction of information on compound-nucleus level densities from blocking experiments is discussed. The application of the formalism to ^{71}As compound states seen in $^{70}Ge(p,p')$ reactions in germanium crystals is described. (J.W.R.)

1398 THREE-PARTICLE WAVE FUNCTION IN THE LOWEST APPROXIMATION IN THE INTERACTION RADIUS. Beloozerov, N. N. (All-Union Inst. of Scientific and Tech. Information, Moscow). Yadern. Fiz.; 14: No. 2, 328-42(Aug 1971). (In Russian).

A method is proposed to construct the three-particle bound-state wave function in the lowest approximation in the interaction radius. The method enables one to consider stable bound states when the three-particle bound energy is more than the two-particle bound energy. It is shown that with the parameters near to the nucleon values there is one level in the three-body system with bound energy near 10 MeV. (auth)

1399 PROBLEM OF THE CRITICAL CHARGE OF NUCLEUS. Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 14: No. 2, 458-68(Aug 1971). (In Russian).

The critical charge Z_{cr} is by definition the value of the charge of nucleus (or of the system of nuclei) at which the energy of the ground state of the discrete spectrum decreases down to the boundary of the lower continuum $E = -mc^2$. To calculate Z_{cr}, the method of the effective potential is developed and the variational principle is formulated. With their help one can obtain Z_{cr} for the system of two colliding nuclei. (auth)

1400 α-DECAY OF DEFORMED NUCLEI. Kadmenskii, S. G.; Kalechints, V. E.; Martynov, A. A. (Voronezh State Univ., USSR). Yadern. Fiz.; 14: No. 2, 343-53(Aug 1971). (In Russian).

The α-decay of deformed nuclei is studied in terms of the approach in which the α-decay width is determined by the overlapping integral of the parent nucleus wave function, of the nuclear potential of the α-particle interaction with the daughter nucleus, and of the wave function of the final channel. Using the quasistationary wave function of the decaying system, the formulas for the angular distributions and absolute widths of the α-decay are constructed. Angular distributions of α-particles emitting from oriented nuclei are studied and possibilities of existence of anomalous angular distributions are discussed. The ^{242}Cm α-decay absolute widths calculated for the first three levels of the main rotational band of the daughter nucleus appear to be in close agreement with the results by Mang and Rasmussen. (auth)

1401 APPLICATION OF THE K-HARMONICS METHOD TO THE CALCULATION OF NUCLEAR PROPERTIES IN THE $K = K_{min} + 1$ APPROXIMATION. Zhukov, M. V.; Shitikova, K. V. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 14: No. 2, 297-203(Aug 1971). (In Russian).

A method is proposed to calculate the properties of levels with anomalous parity in nuclei in the $(K_{min} + 1)$ approximation of the K-harmonics method. The method allows one to use the apparatus of the translation-invariant shell model. The calculation of the ^{16}O nucleus is given as an illustration. (auth)

1402 FISSION FRAGMENT ANGULAR DISTRIBUTION AT INTERMEDIATE EXCITATION ENERGIES. Ohta, Kohichi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 45: No. 6, 1808-16(Jun 1971).

Working within the framework of the pairing-plus-octupole model in the cluster representation, the effective moment of inertia of the fissioning nucleus at the saddle point is calculated as a function of the excitation energy and compared with experiment in the case of plutonium. The restriction of valence states within the last unfilled major shell is found to be unfavorable for a description of the nucleus at high excitation energies. When a larger energy interval is assumed for the valence nucleons, theory and experiment are shown to be in good agreement. (auth)

1403 TWO-CLUSTER APPROACH IN INTEGRAL EQUATIONS FOR N PARTICLES. Narodetskii, I. M.; Yakubovskii, O. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 14: No. 2, 315-27(Aug 1971). (In Russian).

A method for calculation of the threshold states based on the pole approximation in the integral equations for a system of several nucleons is presented. A variant of the N-particle integral equations is formulated in such a way that the separation of the two-cluster structure may be fulfilled most naturally. The pole approximation for 4 particles corresponding to the cluster decompositions 4 = 3 + 1 and 4 = 2 + 2 is considered in detail, as well as the cluster decomposition N = (N – 1) + 1 in the N-particle equation. (auth)

1404 BASIS WAVE FUNCTIONS AND OPERATOR MATRICES OF COLLECTIVE NUCLEAR MODEL. Budnik, A. P.; Gai, E. V.; Rabotnov, N. S.; (and others). Yadern. Fiz.; 14: No. 2, 304-14(Aug 1971). (In Russian).

Wave functions corresponding to harmonic quadrupole vibrations of the nuclear surface shape are obtained in a physical basis, i.e. with separation of an explicit dependence on variables and quantum numbers of the physical space rotation group, O(3). As a result of using the language REFAL to automatize the cumbersome analytic calculations, an explicit form of the functions up to high values of the quantum numbers was obtained (angular momentum J = 12 and seniority $\lambda = 14$. The constructed functions are applied to calculate the matrix elements of the fundamental operators used in calculations in the collective phenomenological nuclear model: electric monopole, magnetic dipole and electric quadrupole moments. (auth)

1405 FISSION PROBABILITY AND MULTIPLICITY OF FISSION-EVAPORATION CASCADE. Lin, I (Showa-Yakka Coll., Tokyo). Progr. Theor. Phys. (Kyoto); 45: No. 6, 1999-2000(Jun 1971).

A simple method for estimating the fission probability for highly excited nuclei with low fissionability is presented. The amplifying effect of the fission-evaporation cascade on the fission probability is discussed. (J.W.R.)

1406 NUCLEAR MASS FORMULA ON A COMPRESSIBLE MODEL. Kodama, Takeshi; Yamada, Masami (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 45: No. 6, 1763-78(Jun 1971).

A nuclear mass formula in which the nuclear compressibility is taken into account is constructed. It is derived from the Weizsäcker-Bethe formula by regarding the coefficients of the volume, surface and symmetry terms as functions of density and by replacing the Coulomb term by an approximate Coulomb energy calculated on a compressible trapezoidal model. The density dependences of these functions are chosen so that the effect of hard-core interactions can be taken into account. Several constraints are imposed on the parameters from theoretical considerations; and the values of the remaining parameters are fixed by use of the gross features of experimental data on the position of the β-stability line, nuclear masses on it, two-proton separation energies, nuclear sizes and isotope shifts. The formula obtained agrees with experimental data only moderately, but can be used as a starting point for studying nuclear compressibility. (auth)

1407 STUDIES OF THE THREE-BODY PROBLEM. Gloeckle, Walter (Univ., Heidelberg). Nucl. Phys.; A175: No. 2, 337-49(1971).

In order to test the usefulness of a set of equations derived previously for the three-body problem, the method of Padé approximants is used to solve this set. In a model calculation the binding energy of three particles, already known by other methods, is exactly reproduced. Furthermore, the first eigenfunctions for a Hilbert-Schmidt kernel in two variables, which occurs in the set of equations, are determined. (auth)

1408 COLLECTIVE EFFECTS IN THE j^n CONFIGURATION. Vallieres, M.; Dreizler, R. M. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys.; A175: No. 2, 272-88(1971).

The structure of selected states of the configuration $j^n = {}^{13}/_2$, ${}^{17}/_2$, ${}^{21}/_2$ and n = 4, 6 is investigated as a function of the relative coupling strength by using a model Hamiltonian with pairing and quadrupole forces. Exact results for excitation energies, E2 transition rates, and two-particle transfer spectroscopic amplitudes are presented and compared with the results of previous approximate variational

calculations [Dreizler and Klein, Phys. Lett. 30B: 236(1969)] for the same model. (auth)

1409 SELF-CONSISTENCY IN THE APPLICATION OF BRUECKNER'S METHOD TO DOUBLY-CLOSED-SHELL NUCLEI. Schaefer, L.; Weidenmueller, Hans A. (Univ., Heidelberg. Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A174: No. 1, 1-25(1971).

The relationships between various self-consistency conditions for the single-particle potential U are investigated. These conditions are the Brueckner–Hartree–Fock condition, the requirement that the single-particle orbitals be maximum overlap orbitals, or generalized natural orbitals. The implications of the use of the latter two sets of single-particle functions are examined in detail. It is shown that these two different choices lead to the cancellation of different sets of diagrams in the linked-cluster expansions of various quantities of physical interest. Both sets of basis functions lead to definitions of the particle-hole matrix elements of U which in lowest order coincide with each other, and with that obtained from the Brueckner–Hartree–Fock condition. The definition of the hole-hole matrix elements of U, on the other hand, as obtained from the Brueckner–Hartree–Fock condition is not related to these two sets. (auth)

1410 FERMION CLUSTER EXPANSION FORMALISM FOR ANGULAR MOMENTUM DEPENDENT POTENTIALS. Mueller, G. P. (Naval Research Lab., Washington, D. C.). Nucl. Phys.; A174: No. 1, 113-22(1971).

The usual cluster expansion calculation of the ground state energy of nuclear matter does not allow the use of angular momentum dependent potentials. The modified cluster expansion expressions that arise when a distinct interaction is allowed in each $(^{2S+1}L_J)$ channel are presented here. The effects of the diagonal portions of the J-dependent tensor forces are also included. (auth)

1411 TREATMENT OF ANHARMONICITIES IN THE COLLECTIVE SPECTRA OF INTERMEDIATE NUCLEI. Holzwarth, Gottfried (Technische Univ., Garching, Ger.). Nucl. Phys.; A174: No. 1, 97-112(1971).

The treatment of anharmonicities in the boson expansion together with angular momentum projection which previously has been developed in a one-dimensional (K = 0) model is extended to include all degrees of freedom for the case of quadrupole bosons. The tensor properties of the bosons enable an exact evaluation of the occurring overlap functions, but in principle the approach is not bound to the use of tensor bosons. The comparison with results of the previous model shows that the K = 0 restraint implies effective anharmonicities which cast doubt upon a direct application of the one-dimensional model on intermediate nuclei. (auth)

1412 SUPERFLUID CONDENSATION ENERGY OF NEUTRON MATTER. Yang, C.-H.; Clark, J. W. (Washington Univ., St. Louis). Nucl. Phys.; A174: No. 1, 49-62(1971).

The detailed energetics of pure neutron matter, an ideal form of neutron-star matter, are investigated at low density. The energy shift associated with the normal-to-superfluid-state transition induced by S-wave pairing is estimated by a variational method, with trial superfluid-state and reference normal-state wave functions incorporating strong short-range correlations. The neutron system remains unbound, and indeed there is no indication of a relative minimum of the ground state energy of the (assumed uniform) system as a function of density. However, the transition energy is not entirely negligible compared to the other characteristic energies of the problem—it may be somewhat greater than one-tenth the normal-state energy at densities typical of the inner crust of a neutron star. (auth)

1413 STATISTICAL ESTIMATE OF ONE-PARTICLE STATE DENSITY IN THE SLIGHTLY DEFORMED NILSSON POTENTIAL. Tyapin, A. S. Yadern. Fiz.; 14: No. 1, 88-95 (Jul 1971). (In Russian).

The method is described to obtain statistical estimate of the one-particle state density, the one-particle energy sum, the quadrupole moment, and the mean-square radius in the slightly-deformed Nilsson potential. The connection between the deformation parameters in the drop model and in the Nilsson model is obtained. It is close to the usually used $a_2 = \frac{2}{3}\epsilon$. It is shown that in the Nilsson potentials the shell correction may be calculated with reasonable accuracy using the Strutinsky method. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 234, 235, 239, 287, 379, 418, and 471.

1414 (AECL–3962) FLUX DISTRIBUTION MEASUREMENTS IN THE GENTILLY REACTOR. Okazaki, A.; Walker, D. H.; Roshd, M. H. M. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jul 1971. 60p. Dep. NTIS (U. S. Sales Only). AECL $1,50.

The radial and axial neutron flux distribution measurements made by copper wire activation during the low power commissioning of the Gentilly BLW reactor are described. The radial distributions were measured in an empty booster rod tube located parallel to, and one lattice pitch from, the E-W diameter of the reactor, while the axial distributions were measured in a flux detector thimble four lattice pitches from the reactor center line. Wire scanners with NaI scintillation detectors were used to determine the wire activity. Distributions were obtained with and without light water coolant in the fuel channels and for various absorber and booster rod configurations. The flux plots show the associated flux tilts. (auth)

1415 (BARC/I–80) THE DYNAMIC BEHAVIOUR OF THE RAPP REACTOR. Trasi, M. S. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 10p. INIS.

The dynamic behavior of the RAPP reactor is examined, and the stability of its performance is examined in the linear domain. The results are presented in the form of curves. The frequency response and phase curves are also given. (auth) (INIS)

1416 (CONF–710606–17) UPDATE OF YANKEE ACTIVITIES. Vandenburgh, D. E. (Yankee Atomic Electric Co., Westboro, Mass.). [nd]. 18p.

From 17th annual meeting of the American Nuclear Society; Boston, Mass. (13 Jun 1971).

Engineering, construction, licensing and operating activities carried out by Yankee Atomic Electric Company over several years are summarized. These activities have been accomplished through use of an expanded services organization. The expanded organization is briefly described, and examples of the manner in which it functions is related to projects in progress. A brief recall of the significant events and accomplishments achieved at the Yankee Nuclear Power Station at Rowe is made. Significant technical contributions to the industry, made through operation of Yankee over the years are also discussed. Activities at Connecticut Yankee are summarized. The change in responsibility for operation of that facility is discussed briefly. Vermont Yankee's present status, schedule of activities in the immediate future, and unique problems associated with plant licensing are discussed in greater detail including the various State related problems of jurisdiction and the State's making of regulations. Unique features of plant design are also dealt with. Maine Yankee's present status and schedule of activities in the immediate future are dealt with in lesser detail. The Rome Point Project is discussed. (auth)

1417 (EUR–4475) OPEN-VESSEL EXPERIMENTS ON PLUTONIUM PROTOTYPE ELEMENTS IN THE GARIGLIANO REACTOR. Ariemma, A.; Bramati, L.; Cammarota, U.; Galliani, M.; Lesnoni, G.; Mirone, M.; Paoletti-Gualandi, M.; Peroni, P.; Zaffiro, B.; Gibello, A.; Vandenbroeck, H. (European Communities, Brussels (Belgium). Commission). Apr 1970. 68p. INIS.

During the shutdown of the Garigliano reactor for refuelling (August–September 1968), a series of critical experiments were performed on assemblies containing reload enriched-uranium elements and prototype plutonium elements. The outcome of these experiments was information on the rod power density distributions associated with highly heterogeneous lattices and reactivity variations following replacement of enriched-uranium elements with plutonium elements. The technique used for power density measurements (gamma activity scanning by means of a NaI crystal) proved its outstanding capabilities, because it revealed minor effects on the power densities, such as those due to rod manufacturing tolerances. The good agreement observed in previous criticality experiments between the experimental values and those obtained with the calculation methods adopted by ENEL in the design of plutonium prototype fuel elements was fully confirmed. The power density was calculated with a standard deviation less than 2%, and reactivity with an error below 0.5%. (INIS)

1418 (FIND–50245(7-71)) FIND: MILLSTONE NUCLEAR POWER STATION, UNIT 1. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 2 Jul 1971. 16p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1419 (FIND–50259(10-71)) FIND: BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 15 Oct 1971. 29p. (FIND–50260(10-71); FIND–50296(10-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1420 (FIND–50277(9-71)) FIND: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 24 Sep 1971. 19p. (FIND–50278(9-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1421 (FIND–50289(9-71)) FIND: THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Smith, James G. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 17 Sep 1971. 19p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1422 (FIND–50293(9-71)) FIND: PILGRIM NUCLEAR POWER STATION. Revision 1. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 10 Sep 1971. 19p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1423 (FIND–50348(8-71)) FIND: JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 20 Aug 1971. 13p. (FIND–50364(8-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1424 (FIND–50352(6-71)) FIND: LIMERICK GENERATING STATION, UNITS 1 AND 2. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 25 Jun 1971. 7p. (FIND–50353(6-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1425 (FIND–50358(8-71)) FIND: WILLIAM H. ZIMMER NUCLEAR POWER STATION, UNITS 1 AND 2. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 13 Aug 1971. 13p. (FIND–50359(8-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1426 (FIND–50363(7-71)) FIND: FORKED RIVER NUCLEAR GENERATING STATION, UNIT NO. 1. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 22 Jul 1971. 8p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1427 (FIND–50366(7-71)) FIND: EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 29 Jul 1971. 7p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1428 (FIND–50367(7-71)) FIND: BAILLY GENERATING STATION, NUCLEAR 1. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 30 Jul 1971. 11p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1429 (FIND–50368(8-71)) FIND: ARKANSAS NUCLEAR ONE, UNIT 2. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 6 Aug 1971. 9p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1430 (FIND–50369(7-71)) FIND: McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 9 Jul 1971. 9p. (FIND–50370(7-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1431 (FIND–50373(8-71)) FIND: LA SALLE COUNTY STATION, UNITS 1 AND 2. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 27 Aug 1971. 8p. (FIND–50374(8-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1432 (FIND–50382(9-71)) FIND: WATERFORD STEAM ELECTRIC STATION, UNITS 3 AND 4. Smith, James G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 3 Sep 1971. 8p. (FIND–50383(9-71)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

1433 (IEA–15) UKAEA PAPERS DELIVERED AT SEMINARS IN BRAZIL DURING MARCH 1969. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec 1969. 64p. Dep. NTIS (U. S. Sales Only).

Three papers delivered at nuclear facilities by United Kingdom Atomic Energy Authority representatives are presented. The papers discuss experience with British nuclear power stations and the development of the AGR and SGHWR, factors affecting the costs of nuclear power stations, and power reactor fuel services and supplies of the U.K.A.E.A. (H.D.R.)

1434 (WCAP–7769) OVERPRESSURE PROTECTION FOR WESTINGHOUSE PRESSURIZED WATER REACTORS. Mangan, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa.). Oct 1971. 13p.

In a Westinghouse Pressurized Water Reactor protection against overpressurization of either the Reactor Coolant System or the Steam System is provided by the combination of the steam generator safety valves, pressurizer safety valves, and the Reactor Protection System. Following a complete loss of heat sink, i.e., steam flow to the turbine, protection against overpressure is afforded by the pressurizer and steam generator safety valves along with any of the following reactor trip functions: (1) Reactor Trip on Turbine Trip (if the turbine is tripped); (2) High Pressurizer Pressure Reactor Trip; (3) Overtemperature ΔT Reactor Trip; (4) Low Feedwater Flow Reactor Trip; or (5) Low-Low Steam Generator Water Level Reactor Trip. (auth)

1435 NUCLEAR ENERGY REQUIREMENTS OF THE UK DURING THE NEXT DECADE AND THE ROLE OF INDUSTRY. Brown, Gordon (Humphreys and Glasgow Ltd., Eng.). Chartered Mech. Eng.; 18: No. 8, 291(Sep 1971).

The contribution of nuclear power to the energy requirements in the UK in the last decade is considered and it is concluded that the order book at the moment is inadequate to maintain one efficient design and construction company. This situation is compared with the position overseas and it is considered that, to survive, the UK industry must look outwards and seek associations overseas to develop a policy and adopt a reactor type which will sell throughout the world. The prospect of entry into the Common Market in this context is reviewed. (UK)

1436 NUCLEAR POWER FOR ELECTRICITY GENERATION. Bainbridge, G. R. (United Kingdom Atomic Energy Authority, Risley, Eng.). Chartered Mech. Eng.; 18: No. 8, 292-303 (Sep 1971).

A review is given of the progress throughout the world of power reactors. The many types of reactor design both experimental and commercial are described. (UK)

1437 SURVEY OF DEVELOPING NUCLEAR MARKETS. Nucl. Eng. Int.; 16: No. 184, 745-73(Sep 1971).

The role of the IAEA in assisting in the introduction of nuclear power into the developing countries is described. A review of the long-term fuel supply situation is presented. The prospects for nuclear power are analyzed for the following countries: Australia, New Zealand, Yugoslavia, Norway, Denmark, Finland, South Africa, India, Pakistan, S. Korea, Taiwan, Thailand, Israel, Mexico, and South American countries. A folding chart shows the principal national and industrial organizations, and reactor status, for each country. (UK)

1438 SOME ASPECTS OF GENERATION PLANNING PHILOSOPHY EXPLAINED. Clark, D. (Central Electricity Generating Board, London). Elec. Rev.; 189: No. 9, 292-4 (Aug 1971).

Difficulties in future planning for electricity generation are discussed. Considerations of economy and security of supply have tended to restrict the scope for technical innovation mainly to the nuclear field, where long term expansion is considered essential. Newer types of conventional generating plant are assessed. The need for fast reactors is recognized. (UK)

1439 SAFETY EXAMINATION ON PROSPECTIVE REACTOR INSTALLATION IN HAMAOKA POWER STATION OF CHUBU ELECTRIC POWER COMPANY. Genshiryoku Iinkai Geppo; 15: No. 12, 86-97(Dec 1970). (In Japanese).

The Hamaoka Power Reactor Unit 1 is to be situated on the coast facing the Pacific in Shizuoka Pref. The reactor plant is a BWR of heat output 1,593 MW (540 MW(e)); fuel is slightly enriched uranium dioxide with Zircaloy-2 cladding. The following topics are described: outline of the installation such as site conditions and nuclear reactor; safety design and safety measures on nuclear and thermal design, fuel, control, containment and cooling, wastes, safety, aseismatic design, etc.; radiation exposure in normal operation due to radioactive wastes; accidents (such as failure and damage of machinery and equipment); serious and imaginary hazards; and technological ability of the applicant. (Japan)

1440 SAFETY INSPECTION ON PROSPECTIVE REACTOR INSTALLATION IN ONAGAWA POWER STATION OF TOHOKU ELECTRIC POWER COMPANY. Genshiryoku Iinkai Geppo; 15: No. 12, 65-76(Dec 1970). (In Japanese).

The Onagawa Power Reactor Unit 1 is to be situated on the Ojika Peninsula facing the Pacific. The reactor plant is a BWR of heat output 1,590 MW (524 MW(e)); fuel is low-enriched uranium dioxide with Zircaloy-2 cladding. Topics described include: outline of the installation such as site conditions and the nuclear reactor; safety design and safety measures on nuclear and thermal design, fuel, control, containment and cooling, wastes, safety, aseismatic design, etc.; radiation exposure in normal operation due to radioactive wastes; accidents such as failure and damage of machinery and equipment; serious and imaginary hazards; and technological ability of the applicants. (Japan)

1441 INSTRUMENTATION SYSTEMS FOR THE SEQUOYAH NUCLEAR PLANT. Patalon, W. (Westinghouse Electric Corp., Pittsburgh); Pierce, R. Nucl. Eng. Int.; 16: No. 185, 860-4 (Oct 1971).

The systems adopted for protection, control, and monitoring are discussed, and the equipment used is described. A brief outline is given of the function of the computer and the layout of the controls. (UK)

1442 DEVELOPMENT OF A URANIUM REACTOR CALORIMETER. Kott, Josef; Jirousek, Vitezslav; Teren, Samuel; (and others) (Skoda Works, Plzen, Poland). Jad. Energ.; 17: No. 8, 254-9(Aug 1971). (In Czech).

Experimental and theoretical problems of measuring the heat generated in the fuel in the active zone of the Czech A-1 power reactor are described. The influence of fast neutrons, photon fields, and uranium fission on the calorimetric probe is discussed. Calorimetric testing on the RA reactor in Yugoslavia is briefly described. 11 references. (tr-auth)

Operation and Economics

1443 (DOCKET-50029–159) YANKEE NUCLEAR POWER STATION. Operation Report No. 129, September 1971. (Yankee Atomic Electric Co., Westboro, Mass.). 26 Oct 1971. 8p. Dep. NTIS.

1444 (DOCKET-50146–96) SAXTON NUCLEAR EXPERIMENT. Operation Report, March 1, 1971–August 31, 1971. (Saxton Nuclear Experimental Corp., Pa.). 26 Oct 1971. 47p. Dep. NTIS.

1445 (DOCKET-50219–148) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Surveillance Testing Failures.

(Jersey Central Power and Light Co., Morristown, N. J.). 9 Sep 1971. 5p. Dep. NTIS.

Systems failures observed during surveillance testing include: excessive radioactivity levels from the radwaste storage tank due to waste concentrator being out of service; failure of the generator load rejection and turbine trip anticipatory scram bypass switch; failure of minimum flow valve of the standby gas treatment system; and failure of the protection system scram dump volume level switch. (D.C.C.)

1446 (DOCKET-50237-202) DRESDEN NUCLEAR POWER STATION, UNIT 2. Unplanned Release of Radioactive Material, August 7, 1971. (Commonwealth Edison Co., Chicago, Ill.). 17 Aug 1971. 2p. (DOCKET-50249-104). Dep. NTIS.

An unplanned release of radioactive material from the site is described resulting from the discharge to the river of "B" floor drain sample tank prior to sampling. (D.C.C.)

1447 (DOCKET-50237-204) DRESDEN NUCLEAR POWER STATION, UNIT 2. Hydraulic Shock to the Shutdown Cooling System. (Commonwealth Edison Co., Chicago, Ill.). 1 Nov 1971. 11p. Dep. NTIS.

On September 28, 1971, a hydraulic shock or water hammer was experienced during testing of the isolation valves for the shutdown cooling system. Possible causes for the water hammer are presented. Operating procedures following the incident are described. (D.C.C.)

1448 (DOCKET-50254-57) QUAD-CITIES STATION, UNITS 1 AND 2. Additional Information Concerning Fuel Loading at Unit 2 and Start-Up Testing at Units 1 and 2. (Commonwealth Edison Co., Chicago, Ill.). 28 Oct 1971. 9p. (DOCKET-50265-49). Dep. NTIS.

1449 (DOCKET-50261-75) H. B. ROBINSON UNIT NO. 2. Report of Investigation of Reactor Trip Breaker Malfunction. (Carolina Power and Light Co., Raleigh, N. C.). 29 Oct 1971. 7p. Dep. NTIS.

1450 (DOCKET-50269-39) OCONEE NUCLEAR STATION, UNIT 1. Integrated Leak Rate Test of the Reactor Containment Building. (Duke Power Co., Charlotte, N. C.). 27 Oct 1971. 296p. Dep. NTIS.

1451 (DOCKET-50269-40) OCONEE NUCLEAR STATION, UNIT 1. Structural Integrity Test Report of the Reactor Containment Building. (Bechtel Associates, Gaithersburg, Md.). 29 Oct 1971. 96p. Dep. NTIS.

For Duke Power Co., Charlotte, N. C.

1452 (NYO-3250-62) OPERATION REPORT NO. 71-7 FOR THE MONTH OF JULY. (Connecticut Yankee Atomic Power Co., Haddam). 20 Aug 1971. Contract AT(30-1)-3250. 12p. Dep. NTIS.

1453 (TID-25848) SENA NUCLEAR POWER PLANT OPERATIONS REPORT, JULY 1971. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-Lez-Givet (France)). 38p. Dep. NTIS.

The SENA power reactor was shut down throughout the month for refueling and inspection. The inspection and maintenance activities are summarized. (H.D.R.)

1454 (TID-25849) SENA NUCLEAR POWER PLANT. Report for April 1971. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet (France)). 19p. Dep. NTIS.

The SENA power reactor operated at 99.70% availability for the month. One accidental trip occurred during testing of the turbine safety devices. The plant operating statistics, fuel inventory, and maintenance activities are reported. (H.D.R.)

1455 ACADEMIC AND LABORATORY COURSES FOR NUCLEAR POWER PLANT PERSONNEL. Deutsch, Robert W. (Catholic Univ. of America, Washington, D. C. General Physics Corp., Columbia, Md.). Nucl. News; 14: No. 9, 47-50(Sep 1971).

Training requirements for operating personnel for power reactors are described. Typical study courses for personnel are listed. Training programs are discussed. (D.C.C.)

Safety and Siting

1456 (DOCKET-1151-47) ELK RIVER REACTOR. Technical Specifications, Amendment No. 1, Dismantling Plan. (Rural Cooperative Power Association, Elk River, Minn.). 1 Nov 1971. 81p. Dep. NTIS.

1457 (DOCKET-1155-139) LA CROSSE BOILING WATER REACTOR. Containment Vessel Class-A Integrated Leak Rate Test of November 1970. (Dairyland Power Cooperative, La Crosse, Wis.). 12 Oct 1971. 23p. (DPC-851-34). Dep. NTIS.

1458 (DOCKET-50003-93) INDIAN POINT STATION, UNIT NO. 1. Changes During Six Months Ending September 30, 1971. (Consolidated Edison Co. of New York, Inc., New York). 27 Oct 1971. 2p. Dep. NTIS.

Design modifications for reactor systems during April to September 1971 are described. (D.C.C.)

1459 (DOCKET-50146-95) SAXTON NUCLEAR EXPERIMENT. Answer to Comments on Inspection of May 11-14, 1971. (Division of Compliance (AEC), Washington, D. C.). 21 Jul 1971. 7p. Dep. NTIS.

Requested information is presented concerning the minimum sensitivity of the stack monitor. (D.C.C.)

1460 (DOCKET-50213-118) CONNECTICUT YANKEE ATOMIC POWER PLANT. Technical Specifications, Amendment 22, Emergency Plan. (Connecticut Yankee Atomic Power Co., Haddam). 15 Oct 1971. 138p. Dep. NTIS.

1461 (DOCKET-50219-150) OYSTER CREEK NUCLEAR PLANT UNIT 1. Provisional Operating License No. DPR-16, Amendment No. 3. (Division of Reactor Licensing (AEC), Washington, D. C.). 5 Nov 1971. 52p. Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects for the reactor. The safety evaluation by the Division of Reactor Licensing is included. (D.C.C.)

1462 (DOCKET-50237-205) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Technical Specification Change No. 16, Unit 2; and Technical Specification Change No. 8, Unit 3. (Division of Reactor Licensing (AEC), Washington, D. C.). 3 Nov 1971. 25p. (DOCKET-50249-106). Dep. NTIS.

Revised technical specifications are presented concerning: lowering of the turbine-control-oil pressure scram setpoint; fewer surveillance requirements for the intermediate range monitor instrumentation; addition of an average power range monitor control rod block function; and addition of a control rod block function based on intermediate range monitor detection position. (D.C.C.)

1463 (DOCKET-50245-100) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Supplement to Statement Why Operating License Should not be Suspended Pending Completion of NEPA Environmental Review. (Northeast Utilities Service Co., Hartford, Conn.). 1 Nov 1971. 5p. Dep. NTIS.

1464 (DOCKET-50247-53) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Final Safety Analysis Report, List of Design Changes. (Consolidated Edison Co. of New York, Inc., New York). 8 Oct 1971. 5p. Dep. NTIS.

1465 (DOCKET-50249-107) DRESDEN NUCLEAR POWER STATION, UNIT 3. Environmental Report, Supplement 1. (Commonwealth Edison Co., Chicago, Ill.). 8 Nov 1971. 109p. Dep. NTIS.

Information concerning radioactive discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1466 (DOCKET-50249-108) DRESDEN NUCLEAR POWER STATION, UNIT 3. Additional Information Concerning the Environmental Impact. (Commonwealth Edison Co., Chicago, Ill.). 8 Nov 1971. 2p. Dep. NTIS.

Requested additional information is presented concerning the operation of the cooling lake for thermal discharges from the reactor. (D.C.C.)

1467 (DOCKET-50249-109) DRESDEN NUCLEAR POWER STATION, UNIT 3. Technical Specifications, Change No. 6. (Division of Reactor Licensing (AEC), Washington, D. C.). 11 Nov 1971. 2p. Dep. NTIS.

Revised technical specifications are presented concerning startup transient tests to be conducted without flow-biased scram protection. The flow-biased scram protection is replaced by a fixed 120% high flux average power range monitor scram during the tests. (D.C.C.)

1468 (DOCKET-50250-51) TURKEY POINT PLANT, UNITS NO. 3 AND NO. 4. Final Safety Analysis Report, Rev. 18. (Florida Power and Light Co.). 18 Oct 1971. 346p. (DOCKET-50251-46). Dep. NTIS.

Revised and additional data are presented on the following topics: cooling system; emergency plans; personnel qualifications; and technical specifications. (D.C.C.)

1469 (DOCKET-50250-52) TURKEY POINT PLANT, UNITS 3 AND 4. Schedule for Cooling System. (Florida Power and Light Co.). 2 Nov 1971. 2p. (DOCKET-50251-47). Dep. NTIS.

1470 (DOCKET-50250-53) TURKEY POINT PLANT, UNITS NO. 3 AND NO. 4. Environmental Report, Supplement. (Florida Power and Light Co.). 8 Nov 1971. 349p. (DOCKET-50251-48). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Geological, hydrological, and meteorological data for the reactor site are included. (D.C.C.)

1471 (DOCKET-50250-54) TURKEY POINT PLANT, UNITS NO. 3 AND NO. 4. Statement Why the Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Sources of Expert Opinion and Authorities. (Florida Power and Light Co.). 3 Nov 1971. 6p. (DOCKET-50251-49). Dep. NTIS.

1472 (DOCKET-50254-54) QUAD-CITIES STATION, UNITS 1 AND 2. Request to Install Energy Absorbing System on Spent Fuel Pools. (Commonwealth Edison Co., Chicago, Ill.). 22 Oct 1971. 5p. (DOCKET-50265-46). Dep. NTIS.

1473 (DOCKET-50254-55) QUAD-CITIES STATION, UNITS 1 AND 2. Environmental Impact Report, Supplemental Information to Environmental Report, Volume 1. (Commonwealth Edison Co., Chicago, Ill.). 1 Nov 1971. 308p. (DOCKET-50265-47). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1474 (DOCKET-50254-56) QUAD-CITIES STATION, UNITS 1 AND 2. Environmental Impact Report, Supplemental Information to Environmental Report, Volume 2. (Battelle Columbus Labs., Ohio). Nov 1971. 83p. (DOCKET-50265-48). Dep. NTIS.

For Commonwealth Edison Co., Chicago, Ill.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1475 (DOCKET-50259-28) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 14. (Tennessee Valley Authority, Chattanooga. Office of Power). 28 Oct 1971. 210p. (DOCKET-50260-27; DOCKET-50296-26). Dep. NTIS.

Revised design parameters of the Browns Ferry Power Reactor Units 1, 2, and 3 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

1476 (DOCKET-50261-76) H. B. ROBINSON UNIT NO. 2. Environmental Report. (Carolina Power and Light Co., Raleigh, N. C.). 4 Nov 1971. 292p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1477 (DOCKET-50261-77) H. B. ROBINSON UNIT NO. 2. Emergency Core Cooling System, Additional Information. (Carolina Power and Light Co., Raleigh, N. C.). 5 Nov 1971. 2p. Dep. NTIS.

1478 (DOCKET-50263-89) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Environmental Report. (Northern States Power Co., Minneapolis, Minn.). 5 Nov 1971. 474p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Geological and meteorological data for the reactor site are included. (D.C.C.)

1479 (DOCKET-50266-57) POINT BEACH NUCLEAR PLANT, UNIT 1. Environmental Report, Operating License Stage, Supplement. (Wisconsin Electric Power Co., Milwaukee). 8 Nov 1971. 678p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1480 (DOCKET-50267-35) FORT ST. VRAIN NUCLEAR GENERATING STATION, UNIT 1. Environmental Report, Suppl. 1. (Public Service Co. of Colorado, Denver). 18 Oct 1971. 92p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1481 (DOCKET-50269-38) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Statement Why Operating License and Construction Permits Should Not be Suspended Pending Completion of NEPA Environmental Review. (Duke Power Co., Charlotte, N. C.). 18 Oct 1971. 262p. (DOCKET-50270-34; DOCKET-50287-31). Dep. NTIS.

1482 (DOCKET-50269-41) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Supplemental Environmental Report, Rev. 1. (Duke Power Co., Charlotte, N. C.). 2 Nov 1971. 10p. (DOCKET-50270-35; DOCKET-50287-32). Dep. NTIS.

Additional information is presented concerning radioactive discharges from the reactors. (D.C.C.)

1483 (DOCKET-50271-64) VERMONT YANKEE NUCLEAR POWER STATION. Fuel Enrichments. (Vermont Yankee Nuclear Power Corp., Rutland). 29 Oct 1971. 4p. Dep. NTIS.

Enrichment deviations in the UO_2 fuel rods for the Vermont Yankee Power Reactor are analyzed. (D.C.C.)

1484 (DOCKET-50272-21) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Statement Why the Construction Permits Should Not Be Suspended Pending Completion of the NEPA Environmental Review, Additional Information. (Public Service Electric and Gas Co., Newark, N. J.). 5 Nov 1971. 11p. (DOCKET-50311-21). Dep. NTIS.

1485 (DOCKET-50272-22) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Operating License Stage, Supplement. (Public Service Electric and Gas Co., Newark, N. J.). 5 Nov 1971. 203p. (DOCKET-50311-22). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1486 (DOCKET-50275-17) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Additional Information. (Pacific Gas and Electric Co., San Francisco, Calif.). 4 Nov 1971. 6p. (DOCKET-50323-15). Dep. NTIS.

1487 (DOCKET-50277-25) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Amendment No. 11. (Philadelphia Electric Co., Pa.). 2 Nov 1971. 123p. (DOCKET-50278-25). Dep. NTIS.

Revised design parameters of the Peach Bottom Power Reactor Units 2 and 3 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

1488 (DOCKET-50277-26) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Environmental Report, Operating License Stage, Suppl. 1, Pt. 1. (Philadelphia Electric Co., Pa.). Nov 1971. 185p. (DOCKET-50278-26). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1489 (DOCKET-50277-27) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Environmental Report, Operating License Stage, Suppl. 1, Pt. 2. (Philadelphia Electric Co., Pa.). Nov 1971. 413p. (DOCKET-50278-27). Dep. NTIS.

Limnological data for the Conowingo Reservoir are presented. Information concerning radioactive discharges from the reactors is presented. (D.C.C.)

1490 (DOCKET-50280-53) SURRY POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Amendment No. 27. (Virginia Electric and Power Co., Richmond). 3 Nov 1971. 10p. (DOCKET-50281-49). Dep. NTIS.

Revised design parameters of the Surry Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

1491 (DOCKET-50282-42) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Environmental Report, Operating License Stage, Suppl. 1, Vol. 1. (Northern States Power Co., Minneapolis, Minn.). 5 Nov 1971. 285p. (DOCKET-50306-41). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Geological, hydrological, and meteorological data for the reactor site are included. (D.C.C.)

1492 (DOCKET-50282-43) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Environmental Report, Operating License Stage, Suppl. 1, Vol. 2. (Northern States Power Co., Minneapolis, Minn.). 5 Nov 1971. 193p. (DOCKET-50306-42). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1493 (DOCKET-50285-50) FORT CALHOUN STATION, UNIT NO. 1. Revised Environmental Report. (Omaha Public Power District, Nebr.). 4 Nov 1971. 341p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1494 (DOCKET-50289-40) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Statement Why Construction Permits Should Not be Suspended Pending Completion of NEPA Environmental Review. (Metropolitan Edison Co., Reading, Pa.). 19 Oct 1971. 70p. (DOCKET-50320-22). Dep. NTIS.

1495 (DOCKET-50289-41) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Additional Information. (Metropolitan Edison Co., Reading, Pa.). 4 Nov 1971. 5p. (DOCKET-50320-24). Dep. NTIS.

1496 (DOCKET-50293-57) PILGRIM NUCLEAR POWER STATION. Final Safety Analysis Report, Amendment No. 31. (Boston Edison Co., Mass.). 9 Nov 1971. 91p. Dep. NTIS.

Additional data concerning radioactive waste disposal systems are presented. (D.C.C.)

1497 (DOCKET-50295-31) ZION STATION, UNITS 1 AND 2. Statement Why Construction Permits Should Not be Suspended Pending Completion of NEPA Environmental Review. (Commonwealth Edison Co., Chicago, Ill.). 18 Oct 1971. 4p. (DOCKET-50304-30). Dep. NTIS.

1498 (DOCKET-50295-33) ZION STATION, UNITS 1 AND 2. Environmental Report, Supplement 1. (Commonwealth Edison Co., Chicago, Ill.). 8 Nov 1971. 112p. (DOCKET-50304-32). Dep. NTIS.

Information concerning radioactive discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1499 (DOCKET-50298-23) COOPER NUCLEAR STATION. Statement Why Construction Permit Should Not be Suspended Pending Completion of NEPA Environmental Review. (Nebraska Public Power District, Columbus). 15 Oct 1971. 96p. Dep. NTIS.

1500 (DOCKET-50301-42) POINT BEACH NUCLEAR PLANT, UNIT NO. 2. Safety Evaluation by Division of Reactor Licensing, Addendum No. 4. (Division of Reactor Licensing (AEC), Washington, D. C.). 2 Nov 1971. 19p. Dep. NTIS.

1501 (DOCKET-50301-43) POINT BEACH NUCLEAR PLANT, UNIT NO. 2. Environmental Report, Operating License Stage, Supplement. (Wisconsin Electric Power Co., Milwaukee). 8 Nov 1971. 683p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1502 (DOCKET-50305-27) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 11, Design Report of the Containment Fan Coil Units. (Wisconsin Public Service Corp., Green Bay). 20 Oct 1971. 218p. Dep. NTIS.

1503 (DOCKET-50305-28) KEWAUNEE NUCLEAR POWER PLANT. Environmental Report, Operating License Stage, Revised November 1971. (Wisconsin Public Service Corp., Green Bay). 8 Nov 1971. 422p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Hydrological and meteorological data for the reactor site are included. (D.C.C.)

1504 (DOCKET-50309-43) MAINE YANKEE ATOMIC POWER STATION. Statement Supporting Uninterrupted Construction. (Maine Yankee Atomic Power Co., Westboro, Mass.). 15 Oct 1971. 17p. Dep. NTIS.

1505 (DOCKET-50312-27) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Additional Information. (Sacramento Municipal Utility District, Calif.). 2 Nov 1971. 11p. Dep. NTIS.

1506 (DOCKET-50313-32) ARKANSAS NUCLEAR ONE, UNIT 1. Statement Why Construction Permit Should Not be Suspended Pending Completion of NEPA Environmental Review. (Arkansas Power and Light Co., Little Rock). 15 Oct 1971. 39p. Dep. NTIS.

1507 (DOCKET-50313-33) ARKANSAS NUCLEAR ONE, UNIT 1. Environmental Report, Suppl. 1. (Arkansas Power and Light Co., Little Rock). 5 Nov 1971. 324p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1508 (DOCKET-50315-50) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Statement Why Construction Permits Should Not be Suspended Pending Completion of NEPA Environmental Review. (Indiana and Michigan Electric Co., New York). 18 Oct 1971. 67p. (DOCKET-50316-50). Dep. NTIS.

1509 (DOCKET-50315-51) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment No. 18. (Indiana and Michigan Electric Co., New York). 25 Oct 1971. 109p. (DOCKET-50316-51). Dep. NTIS.

Requested additional data on design parameters and operation aspects of Donald C. Cook Power Reactor Units 1 and 2 are presented. (D.C.C.)

1510 (DOCKET-50315-52) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Additional Information. (American Electric Power Service Corp., New York). 4 Nov 1971. 2p. (DOCKET-50316-52). Dep. NTIS.

1511 (DOCKET-50317-30) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Supplement. (Baltimore Gas and Electric Co., Md.). 8 Nov 1971. 374p. (DOCKET-50318-30). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1512 (DOCKET-50320-23) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment No. 12. (Metropolitan Edison Co., Reading, Pa.). 28 Oct 1971. 31p. Dep. NTIS.

Requested additional information is presented concerning the post-tensioning anchorage system for the reactor building. (D.C.C.)

1513 (DOCKET-50321-25) EDWIN I. HATCH NUCLEAR PLANT, UNIT NO. 1. Final Safety Analysis Report, Amendment No. 10. (Georgia Power Co., Atlanta). 21 Oct 1971. 47p. Dep. NTIS.

Safety aspects related to the possible failure of the reactor shutdown protection system are analyzed. (D.C.C.)

1514 (DOCKET-50321-26) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Additional Information. (Georgia Power Co., Atlanta). 4 Nov 1971. 11p. Dep. NTIS.

1515 (DOCKET-50324-24) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Environmental Report. (Carolina Power and Light Co., Raleigh, N. C.). 4 Nov 1971. 305p. (DOCKET-50325-24). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1516 (DOCKET-50327-21) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Environmental Statement. (Tennessee Valley Authority, Chattanooga). 19 Oct 1971. 291p. (DOCKET-50328-21). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1517 (DOCKET-50331-29) DUANE ARNOLD ENERGY CENTER. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review,

Additional Information. (Iowa Electric Light and Power Co., Cedar Rapids). 5 Nov 1971. 8p. Dep. NTIS.

1518 (DOCKET-50333-33) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Supplement to Applicants' Statement Pursuant to 10 CFR Part 50 Appendix D, Section E. (Power Authority of the State of New York). 26 Oct 1971. 10p. Dep. NTIS.

Additional information is presented concerning the request for not suspending the construction permit. (D.C.C.)

1519 (DOCKET-50334-27) BEAVER VALLEY POWER STATION. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Additional Information. (Duquesne Light Co., Pittsburgh, Pa.). 4 Nov 1971. 4p. Dep. NTIS.

1520 (DOCKET-50335-21) HUTCHINSON ISLAND PLANT, UNIT NO. 1. Statement Why Construction Permit Should Not Be Suspended Pending Completion of NEPA Environmental Review, Sources of Expert Opinion and Authorities. (Florida Power and Light Co.). 3 Nov 1971. 7p. Dep. NTIS.

1521 (DOCKET-50336-24) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Supplement to Statement of Reasons Why Construction Should Not be Suspended Pending Completion of the NEPA Environmental Review. (Millstone Point Co., Hartford, Conn.). 1 Nov 1971. 10p. Dep. NTIS.

1522 (DOCKET-50344-23) TROJAN NUCLEAR PLANT. Environmental Report, Operating License Stage, Supplement. (Portland General Electric Co., Oreg.). 8 Nov 1971. 450p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Geological, hydrological, and meteorological data for the reactor site are included. (D.C.C.)

1523 (DOCKET-50344-24) TROJAN NUCLEAR PLANT. Discussions and Findings Relative to Suspension of the Construction Permit Pending NEPA Environmental Review. (Division of Reactor Licensing (AEC), Washington, D. C.). 12 Nov 1971. 22p. Dep. NTIS.

1524 (DOCKET-50346-21) DAVIS-BESSE NUCLEAR POWER STATION. Environmental Report, Construction Permit Stage, Supplement, Vol. 1. (Toledo Edison Co., Ohio). 5 Nov 1971. 308p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1525 (DOCKET-50346-22) DAVIS-BESSE NUCLEAR POWER STATION. Environmental Report, Construction Permit Stage, Supplement, Vol. 2. (Toledo Edison Co., Ohio). 12 Nov 1971. 371p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Hydrological and meteorological data for the reactor site are included. (D.C.C.)

1526 (DOCKET-50346-23) DAVIS-BESSE NUCLEAR POWER STATION. Statement of Reasons Why Construction Permit Should Not Be Suspended Pending Completion of Review, Additional Information. (Toledo Edison Co., Ohio). 5 Nov 1971. 2p. Dep. NTIS.

1527 (DOCKET-50348-28) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Statement of Reasons Why Construction Should Not be Suspended Pending Completion of the NEPA Review. (Alabama Power Co., Birmingham). 22 Oct 1971. 77p. (DOCKET-50364-22). Dep. NTIS.

1528 (DOCKET-50348-29) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Environmental Report, Construction Permit Stage. (Alabama Power Co., Birmingham). 29 Oct 1971. 345p. (DOCKET-50364-23). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1529 (DOCKET-50366-18) EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Preliminary Safety Analysis Report, Amendment 12. (Georgia Power Co., Atlanta). 25 Oct 1971. 98p. Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the reactor. (D.C.C.)

1530 (DOCKET-50368-18) ARKANSAS NUCLEAR ONE, UNIT 2. Preliminary Safety Analysis Report, Amendment No. 14. (Arkansas Power and Light Co., Little Rock). 13 Oct 1971. 56p. Dep. NTIS.

Revised and additional data on the design parameters and operations aspects of the Arkansas Nuclear One Power Reactor Unit 2 are presented. (D.C.C.)

1531 (DOCKET-50368-19) ARKANSAS NUCLEAR ONE, UNIT 2. Preliminary Safety Analysis Report, Amendment No. 15. (Arkansas Power and Light Co., Little Rock). 10 Nov 1971. 35p. Dep. NTIS.

Revised and additional data are presented on instrumentation, control systems, and radiation protection systems. (D.C.C.)

1532 (DOCKET-50369-15) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Revision No. 10. (Duke Power Co., Charlotte, N. C.). 8 Nov 1971. 209p. (DOCKET-50370-14). Dep. NTIS.

Revised and additional data are presented on design parameters and operations aspects for the McGuire Power Reactor Units 1 and 2. (D.C.C.)

1533 (DOCKET-50373-11) LA SALLE COUNTY STATION, UNITS 1 AND 2. Environmental Report. (Commonwealth Edison Co., Chicago, Ill.). 3 Nov 1971. 319p. (DOCKET-50374-11). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Geological, hydrological, and meteorological data for the reactor site are included. (D.C.C.)

1534 (DOCKET-50376-22) AGUIRRE NUCLEAR PLANT, UNIT NO. 1. Preliminary Facility Description and Safety Analysis Report, Amendment 11. (Puerto Rico Water Resources Authority, San Juan). 8 Nov 1971. 447p. Dep. NTIS.

Revised design parameters of the Aguirre Power Reactor Unit 1 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

1535 (DOCKET-50376-23) AGUIRRE NUCLEAR PLANT, UNIT NO. 1. Environmental Report, Supplement. (Puerto Rico Water Resources Authority, San Juan). 1 Nov 1971. 137p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

1536 (DOCKET-50387-12) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 3. (Pennsylvania Power and Light Co., Allentown). 27 Oct 1971. 83p. (DOCKET-50388-12). Dep. NTIS.

Geological data for the reactor site are presented. (D.C.C.)

1537 (DOCKET-50389-10) HUTCHINSON ISLAND PLANT, UNIT NO. 2. Plans Tabled. (Florida Power and Light Co.). 1 Nov 1971. 1p. Dep. NTIS.

1538 (DOCKET-50395-12) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment No. 3. (South Carolina Electric and Gas Co., Columbia). 12 Oct 1971. 72p. Dep. NTIS.

Revised and additional data on the design parameters and operations aspects of the Virgil C. Summer Power Reactor Unit 1 are presented. (D.C.C.)

1539 (DOCKET-50404-1) NORTH ANNA POWER STATION PROPOSED UNITS 3 AND 4, LOUISA COUNTY, VIRGINIA. Site Environmental Studies. (Dames and Moore, [New York]). 18 Aug 1971. 149p. (DOCKET-50405-1). Dep. NTIS.

For Virginia Electric and Power Co., Richmond.

Geological, hydrological, and seismological data for the reactor site are presented. (D.C.C.)

1540 (DOCKET-50404-2) NORTH ANNA POWER STATION, UNITS 3 AND 4. License Application. (Virginia Electric and Power Co., Richmond). 15 Sep 1971. 100p. (DOCKET-50405-2). Dep. NTIS.

1541 (DOCKET-50404-3) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Vol. 1. (Virginia Electric and Power Co., Richmond). 15 Sep 1971. 300p. (DOCKET-50405-3). Dep. NTIS.

Information on the North Anna Power Reactor Units 3 and 4 is presented under the following broad topics: introduction and summary; site; and reactor. (D.C.C.)

1542 (DOCKET-50404-5) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Vol. 3. (Virginia Electric and Power Co., Richmond). 15 Sep 1971. 279p. (DOCKET-50405-5). Dep. NTIS.

Information on the North Anna Power Reactor Units 3 and 4 is presented under the following broad topics: electrical systems; auxiliary and emergency systems; steam and power conversion systems; radioactive wastes and radiation protection; conduct of operations; and initial tests and operation. (D.C.C.)

1543 (DOCKET-50404-6) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Vol. 4. (Virginia Electric and Power Co., Richmond). 15 Sep 1971. 414p. (DOCKET-50405-6). Dep. NTIS.

Information on the North Anna Power Reactor Units 3 and 4 is presented under the following broad topics: safety analysis; structures and construction; technical specifications; and quality assurance program. (D.C.C.)

1544 (DOCKET-50404-7) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 2. (Virginia Electric and Power Co., Richmond). 27 Oct 1971. 266p. (DOCKET-50405-7). Dep. NTIS.

Revised and additional data are presented on design parameters and operations aspects for the North Anna Power Reactor Units 3 and 4. (D.C.C.)

1545 (WASH-1169) THERMAL EFFECTS AND U.S. NUCLEAR POWER STATIONS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Aug 1971. 45p. GPO $0.50.

The problems facing the utility industry in its attempts to dispose of the waste heat developed in the process of meeting the power demands are summarized and analyzed. Actions that will provide the information needed for decision making are recommended. (83 references) (auth)

1546 SAFETY INSPECTION ON PROSPECTIVE REACTOR INSTALLATION IN GENKAI POWER STATION OF KYUSHU ELECTRIC POWER COMPANY. Genshiryoku Iinkai Geppo; 15: No. 12, 77-85(Dec 1970). (In Japanese).

A report by a safety examination committee on nuclear reactors to the AEC chairman is presented on the reactor installation in the Genkai power station of KEPC. It is to be situated on the Nagasaki Peninsula facing the Genkai Sea. The reactor plant is a PWR of heat output 1,650 MW (559 MW(e)); fuel is low-enriched uranium dioxide with Zircaloy-4 cladding. Contents of the report are on the following: outline of the installation (such as site conditions and the nuclear reactor); safety design and safety measures on nuclear and thermal design, fuel, control, containment and cooling, wastes, safety, aseismic design, etc.; radiation exposure in normal operation due to radioactive wastes; accidents concerning reactivity and mechanical failure; serious and imaginary hazards; and technological ability of the applicant. (Japan)

Steam and Power Conversion Systems

1547 (70-CNA-620) STATUS REPORT FOR BRUCE GENERATING STATION. Chandler, R. W. (Hydro-Electric Power Commission of Ontario, Toronto). 1970. 17p. (CONF-700564-2). Dep. NTIS (U. S. Sales Only).

From tenth annual international conference of the Canadian Nuclear Association; Toronto, Canada (24 May 1970).

Design parameters of the steam conversion systems for the Candu-type reactors are listed. Progress on site preparation is mentioned briefly. (J.M.J.)

Power Reactor Development

1548 (BNWL-1522-3) AEC REACTOR DEVELOPMENT AND TECHNOLOGY PROGRAMS. Technical Activities Quarterly Report, April-June 1971. (Battelle Pacific Northwest Labs., Richland, Wash.). Oct 1971. Contract AT(45-1)-1830. 61p. Dep. NTIS.

CARBON DIOXIDES—yields from radiolysis of carbon monoxide, water vapor, and helium mixtures, (E)
CARBON MONOXIDES—CO–H_2O–He, radiolysis of, yields of carbon dioxide and hydrogen from, (E)
GRAPHITE—radiation effects on dimensional stability of, fast neutron, (E)
HELIUM—CO–H_2O–He, radiolysis of, yields of carbon dioxide and hydrogen from, (E)
HIGH TEMPERATURE LATTICE TEST REACTOR—physics measurements on mockup MSBR and HTGR-type lattices in
HYDROGEN—yields from radiolysis of carbon monoxide, water vapor, and helium mixtures, (E)
MOLTEN SALT BREEDER REACTOR—reactivity worth measurements in mockup lattice of, material
NEUTRONS, FAST—effects on dimensional stability of graphite, (E)
PLUTONIUM NITRATES—criticality of solutions of, effects of gadolinium additions on, (E/T)
REACTOR FUEL ELEMENTS—performance of defected Zircaloy-2 clad mixed oxide, postirradiation examination of, (E)
REACTORS, GAS COOLED—physics parameters of thorium oxide (ThO_2)–plutonium oxide (PuO_2) fueled high temperature, (E)
—cooling systems of graphite moderated, radiolytic reactions in, (E)
REACTORS, GRAPHITE MODERATED—cooling systems of helium cooled, radiolytic reactions in, (E)
WATER VAPOR—CO–H_2O–He, radiolysis of, yields of carbon dioxide and hydrogen from, (E) (H.D.R.)

1549 (GEAP-13719) INTERIM STRESS DESIGN CRITERIA FOR LMFBR VESSEL AND CORE STRUCTURES. Tsui, E. Y. W.; Marron, J. V.; Brown, A. T. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1971. Contract W-7405-eng-26; Subcontract 3446. 125p. Dep. NTIS.

For Oak Ridge National Lab., Tenn.

Interim stress criteria for LMFBR vessel and core structural design were developed. The components to which the criteria apply are classified into two groups: (1) long-life components, and (2) core components. The long-life components are those permanent and semi-permanent components that are shielded from the intense neutron flux of the core to permit them to be operated for the design life of the plant. A basic requirement on these components is that they be shielded so that the fluence they receive does not embrittle them to the point that they can no longer be considered ductile. Also within this grouping will be certain replaceable items which are partially shielded and designed for less than the full life of the plant but which also have fluence limited such that they can be considered ductile throughout their design life and are not subjected to significant swelling or irradiation-induced creep due to high fluence. The core components include those that are subject to sufficient fluence that they may not be considered ductile throughout their life, are subject to significant swelling due to fast flux accumulation, and will be subjected to potential irradiation-induced creep effects. Examples of long-life components are: the reactor container, primary coolant piping, reactor closure assembly, core clamping mechanisms, etc. Examples of short-life components are: fuel assembly hexagonal channels and internals, blanket assemblies, and control assembly channels. The scope involves the establishment of basic stress limits and recommends appropriate accumulative damage criteria considering the effects of hold time (frequency) and mean strain on low-cycle fatigue at temperatures in the creep range. (24 references) (auth)

1550 (HEDL-TME-71-127) FUNCTION TO PREDICT LMFBR HELIUM RELEASE BASED ON BORON CARBIDE IRRADIATION DATA FROM THERMAL REACTORS. Russcher, G. E.; Pitner, A. L. (Hanford Engineering Development Lab., Richland, Wash.). 30 Sep 1971. Contract AT(45-1)-2170. 45p. Dep. NTIS.

An empirical function was developed to represent about 40 sets of irradiated boron carbide helium release data in the simplest form consistent with their observed radiation variables, and within their 10 to 20% accuracies. Helium release was chosen, rather than the customary gas release fraction, in order to use maximum data accuracy. Capture density was selected to relate helium release to the radiation exposure in that region of the specimen, where most of the helium was produced. Helium release data from natural boron carbide irradiated in the Hanford K thermal reactors were correlated with irradiation data from the EBR-II fast reactor in developing the helium release function. To demonstrate the applicability of this function to LMFBR problems, helium release is predicted for boron carbide irradiated in a neutron spectrum typical of Row 7 in the FTR. Within the range of the data used, helium release should be predictable for any fast or thermal reactor environment within an accuracy of about 20%. 9 references. (auth)

1551 (KFK-EXT-8/70-4) PARAMETER FIT BY THE GRADIENT METHOD ON A HYBRID ANALOG COMPUTER. Katz, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Sep 1970. 26p. (In German). INIS.

Optimization problems are treated by the gradient method with help of a hybrid analog computer. After a short description of the gradient method as an optimization strategy, the use of this method on a hybrid computer is illustrated by the simple

example of optimizing the spring and damping coefficients for a mass-spring-system. Furthermore the method is applied to a problem in fast reactor core design (the optimization of support planes for fuel elements) and the usefulness of the method is investigated in detail. (INIS)

1552 (NP-18995) NUCLEAR POWER IN GREAT BRITAIN. THE CURRENT SITUATION AND DIRECTION OF DEVELOPMENT. Thoernqvist, Lennart (Lund Inst. of Tech. (Sweden). Div. of Heat and Power Engineering). 2 Dec 1970. 35p. (In Swedish). Dep. NTIS (U. S. Sales Only).

The situation of nuclear power in Great Britain is observed. The total electrical consumption corresponds to a maximum effect of 40,000 MW. The first British nuclear power program was intended for 5000 MW during the years 1956–1969. Most of the reactors are of magnox-type. The second nuclear power program is planned to give another 8000 MW for the period 1970–1975. The advanced gas cooled reactor was chosen for this program. A review is presented of the operation data of the magnox nuclear power plants. Most of the problems concerned the gas circulators and the equipment for fuel handling. Costs are reviewed, showing that the production cost for the magnox-type nuclear power plants is high compared with coal and oil heated power plants. (Sweden)

1553 (UJV-2476-M) RESISTANCE OF THE CLADDING MATERIAL OF THE ZRR ELEMENT DURING AFTER-COOLING. Cervasek, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1970. 14p. (In Czech). INIS.

Cladding of elements in the ZRR experimental fast reactor is envisaged to be made of steel whose composition corresponds to steel 1 X18H9T by the Soviet GOST Standard or to steel 304 by the American AISI Standard. The results of experiments carried out with these materials in the U.S.S.R. and the U.S.A. are used to assess roughly the resistance of this type of steel under ZRR reactor conditions. (INIS)

1554 HIGH TEMPERATURE GAS REACTOR POWER STATIONS. PART 2. Chaboseau, Jean (Compagnie Electro-Mecanique, Le Bourget, France). Sci. Progr. Decouverte; No. 3434, 53-6(Jun 1971). (In French).

The principal parts of HTR electric power stations are described. The industrial applications of HTR as heat sources are promising and it is likely that they will play a very important part as energy sources in the near future. (France)

1555 HIGH TEMPERATURE GAS REACTOR POWER STATIONS. PART 1. Chaboseau, Jean (Compagnie-Electro-Mecanique, Le Bourget, France). Sci. Progr. Decouverte; No. 3433, 57-64(May 1971). (In French).

The principles of the different types of nuclear reactors are briefly reviewed. The characteristics of HTR and HTR electric power stations are described. (France)

1556 FUNDAMENTAL ASPECTS IN THE STUDY OF THE ESCAPE OF RADIOACTIVE PRODUCTS FROM NUCLEAR REACTORS, BOTH IN OPERATING REGIME AND IN ACCIDENTS. Santos, Agustin Alonso. Energ. Nucl. (Madrid); 15: No. 71, 191-6(May-Jun 1971). (In Spanish).

The safeguards incorporated in the design of reactors to impede the uncontrolled escape of radioactive products during normal operating conditions and in the case of accidents are described. Methods to establish the balance of radioactivity in a reactor under normal operation as a preliminary step in the calculation of the radioactivity which can escape during normal operation are described. The escape under conditions of accident, including explosive accidents and oxidation of the fuel, is also considered. (7 references) (tr-auth)

1557 INCORE-THERMIONIC-REACTOR PROJECT (ITR). Pruschek, R. (INTERATOM, Bensberg, Ger.); Schoen, Th.; Janner, K.; Langpape, R. Atomwirt., Atomtech.; 16: No. 8-9, 472-8(Aug-Sep 1971). (In German).

In 1968, the nuclear research center Juelich commissioned development of an incore-thermionic reactor as well as design of a pilot plant through several private corporations. Development and design progressed sufficiently to show feasibility of the project. The critical experiment was conducted at the Institute for Reactor Development in Juelich. A detailed description is given of the total installation, motivations for construction of an ITR, and status of component development. (H.B.G.)

Kinetics and Dynamics

1558 (ANL-7778) NEUTRONIC AND THERMAL-HYDRAULIC ANALYSES OF MIXED CORES FOR EBR-II. EBR-II Project. Gillette, J. L.; Golden, G. H.; Sehgal, B. R. (Argonne National Lab., Ill.). Jul 1971. Contract W-31-109-eng-38. 58p. Dep. NTIS.

Neutronic and thermal-hydraulic analyses were made on a series of mixed-core loadings in EBR-II. The parameters obtained were compared with normal operational limits of mixed-oxide-fueled subassemblies and the operating constraints of the reactor to determine the feasibility of each loading. With oxide-fuel subassemblies spread throughout a core blanketed with depleted uranium, the maximum oxide-fuel temperatures in rows 3 and 4 were above the limiting value. With oxide-fuel subassemblies only in rows 5 and 6 of a core with a nickel reflector, their maximum temperatures also were too high. However, when a depleted-uranium blanket replaced the nickel reflector, the operating limitations and constraints were all satisfied. With oxide-fuel subassemblies only in the central three rows, their linear power ratings and fuel-centerline temperatures were found to be above the limits set forth. Extensive analysis on an all-oxide-fuel core showed that if the ratio of the enrichment in rows 5 and 6 to that in rows 1-4 is 1.3/1, a relatively flat radial power profile is obtained and all operating limitations and constraints are satisfied. The Doppler coefficient for a single-enrichment oxide core in EBR-II is about –0.00029; that for an oxide core with an enrichment ratio of 1.5/1 is –0.00023. 28 references. (auth)

1559 (ORNL-TM-3464) XENON BEHAVIOR IN THE MOLTEN SALT REACTOR EXPERIMENT. Engel, J. R.; Steffy, R. C. (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 112p. Dep. NTIS.

The xenon poisoning in the Molten Salt Reactor Experiment (MSRE) was extensively studied in an effort to develop an understanding of the behavior mechanisms. Xenon poisoning calculations made prior to the operation of the MSRE were based on a mathematical model that neglected any effects of cover-gas solubility in the salt. These calculations reproduced reasonably well the observed steady-state poisoning as a function of circulating void fraction when an insoluble cover gas, argon, was used but they did not adequately describe the transient behavior. In addition they did not predict the very low xenon poisoning that was observed at low void fractions with a more soluble cover gas, helium. A more detailed mathematical model which allowed inclusion of cover-gas solubility effects was developed in an effort to better describe the observed results. This model successfully described the different poisoning effects with helium and argon at low void fractions but it required the use of mass transport and xenon stripping parameters that differed significantly from the predicted values. These calculations also failed to describe adequately the transient observations. A comparison of calculated and observed effects suggests that (1) circulating bubbles may strongly influence the transport of xenon from the fluid to graphite, and (2) both the gas transport and stripping processes may be affected by operation at power. (41 references) (auth)

Control Systems

Refer also to abstract 1598.

1560 (HPR-123) DESCRIPTION OF SYSTEM HARDWARE FOR THE MAIN PROCESS COMPUTER INSTALLATION AT THE HBWR. Pettersen, Frank (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). May 1971. 55p. Dep. NTIS (U. S. Sales Only).

Process computer development work at the Halden Reactor Project includes data logging and reporting, monitoring, closed loop dynamic control, and sequence control. The main tool of the development work is an IBM-1800 process computer. System hardware of the IBM-1800 installation is described. (H.D.R.)

1561 (ORNL-TM-3303) FURTHER DISCUSSION OF INSTRUMENTATION AND CONTROLS DEVELOPMENT NEEDED FOR THE MOLTEN SALT BREEDER REACTOR. Moore, R. L. (Oak Ridge National Lab., Tenn.). 5 Aug 1971. 18p. Dep. NTIS.

Previously published information concerning the development and evaluation of process instrumentation applicable to molten-salt breeder reactors (MSBR) was updated. Areas where instrumentation techniques and components tested during operation of the Molten-Salt Breeder Experiment may be applicable to the MSBR are described and recommendations for further development are stated. No problems are foreseen that are beyond the present state of the art. (12 references) (auth)

1562 MANUFACTURE AND EXPERIMENT OF COMPENSATED IONIZATION CHAMBER FOR THE NUCLEAR POWER REACTOR. Yook, Chong Chul; Koh, Byung Joon; Park, Yong Jip. J. Korean Inst. Elec. Eng.; 19: No. 4, 18-23(1970).

A neutron detector, in general, can not be utilized as the thermal neutron detecting chamber in the nuclear power reactor, especially P.W.R. due to the characteristics of high temperature, high pressure and high neutron flux in a reactor vessel. An experiment to detect the thermal neutrons at 400°C and high flux of thermal neutron in a power reactor is described. Coating

boron-10 on the aluminium plates by means of surface diffusion method at 600°C for 5 hours in an electric furnace is utilized. A typical chamber which was compensated ionization chamber filled with free air as an ionization gas was also used. The chamber characteristics were checked in the TRIGA MARK-II reactor at the power level from zero to 250 kW. The chamber showed a perfect linear increase to power increase. However, many variations of the measured current were observed within the power of 50kW. (Korean Sci. Abstr.)

Shielding

1563 (CONF-710301–(Vol.1), pp 106-12) ROLE OF CROSS SECTION MINIMA IN THE DEEP PENETRATION OF FAST NEUTRONS. Goldstein, H.; Lidofsky, L. J.; Oblow, E.; Preeg, W. E.; Soran, P.; Weisbin, C. R. (Columbia Univ., New York).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Results of extensive calculations of the transport of fast neutrons in non-hydrogenous media emphasize the significance of cross section minima in determining the characteristics of the deeply penetrating flux. It is concluded that for calculations involving thick shields the scalar flux is most sensitive to the total cross section in the vicinity of the minima. Partial cross sections play a lesser role, and the details of their fluctuations as a function of energy need to be known only in the neighborhood of the dominating minima in the total cross sections. (auth)

1564 (COO–2049-10) FAST NEUTRON TRANSMISSION MEASUREMENTS FOR REACTOR CORE AND SHIELDING MATERIALS. Final Report. Meyer, W.; Mingle, J. O.; Timmons, D. H.; Kirmser, P. G.; Hu, K. K.; Hill, Thomas R.; Thiesing, James W. (Kansas State Univ., Manhattan, Dept. of Nuclear Engineering). 31 Aug 1971. Contract AT(11-1)-2049. 25p. Dep. NTIS.

Activities in the design and performance of double differential fast neutron transmission experiments for semi-infinite slabs of several important reactor core construction and shielding materials including concrete, iron, water and laminated assemblies of these materials of precisely defined structure are reported. These experiments were designed to generate fast neutron penetration data that are necessary to complex core shielding analyses as well as to test and evaluate fast neutron transport codes. 24 references. (auth)

1565 (ORNL-TM-3606) FAST REACTOR SHIELDING ACTIVITY NO. 40 01 61 189A NO. 10028. Monthly Progress Report, September 1971. Mynatt, F. R.; Clifford, C. E.; Gritzner, M. L.; Maerker, R. E. (Oak Ridge National Lab., Tenn.). 18 Oct 1971. 34p. Dep. NTIS.

CONCRETE — neutron attenuation in, (E)
FAST TEST REACTOR — shielding for, discrete ordinates analysis of core support grid-plate
— shielding for, effects of composition on neutron transmission of thermal, (T)
LIQUID METAL FAST BREEDER REACTOR — shielding for, neutron beam attenuation by concrete, (E)
— coolant for, neutron shielding effects of sodium, (E)
NEUTRONS — attenuation in concrete and liquid sodium, (E)
SHIELDING — development of fast reactor, summary of
SODIUM — neutron attenuation in, (E) (H.D.R.)

Cooling Systems

Refer also to abstracts 242, 261, 365, 373, and 384.

1566 (EURFNR-924) MODIFICATION OF THE DESIGN OF INTERMEDIATE HEAT EXCHANGERS FOR SODIUM-COOLED REACTORS USING FERRITIC MATERIALS. Schnauder, H.; Mueller, R. A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK-1387. 28p. Dep. NTIS.

Work performed under United States–Euratom Fast Reactor Exchange Program.

For a sodium/sodium intermediate heat exchanger a comparison is made of the economics of one design of ferritic steel and one made of austenitic steel. A program system was available for the investigation which carries out the most important strength calculations in addition to the thermal design. Under constant operating conditions, the influence of the diameter of the heat exchanger tube and the wall thickness on overall costs, building volume, and heating area is investigated and represented in curves. Moreover, the influence of various operating parameters on the total costs is shown for the optimum tube diameters elaborated. (auth)

1567 (RT/ING-70(12)) DEVELOPMENT AND USE OF A NONLINEAR MODEL FOR A DIRECT CYCLE NUCLEAR POWER PLANT. Barzacchi, M.; Giordano, P.; Mathis, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 9p. (CONF-6709101–1). INIS.

From fifth international analog computation meeting; Basel, Switzerland (5 Sep 1967).

The development of the analog models, carried out to support the dynamic and control studies for the CIRENE reactors, is described. After a brief description of the linear approach, the nonlinear models for core and plant are described, pointing out how by introducing some additional approximations, it is possible to account for the fundamental non-linear phenomena. The models described can be considered as the basic section of a plant simulator, to be used during preliminary design, final design and construction stages, to define the control system scheme and performance, to test the actual controller prototypes and eventually to train plant operators. (INIS)

1568 PHENIX REACTOR: PROBLEMS POSED BY THE REACTOR VESSEL. Lagrange, M. (CEN de Saclay, Gif-sur-Yvette, France). Energ. Nucl. (Paris); 13: No. 3, 176-82 (May 1971). (In French).

The technical and technological problems encountered during the development of the reactor vessel are described. The integration of the primary circuit components necessitated numerous studies using mock-ups, which led to results in agreement with mathematical models. In order to ensure a good structural reliability, the temperature was maintained as low as possible (less than 500°C), and an attempt was made to limit the thermal shock associated with transients. The technological problems relate to the development and transport of very bulky elements, the resistance of mechanical stresses of thermal origin due to vibrations, and seismic effects. The mounting procedure was carried out in such a way as to separate the civil engineering and mechanical engineering aspects so that troublesome stresses could be avoided. Continuous inspection was ensured throughout the fabrication procedure. Instrumentation was developed for confirming the measurements extrapolated from the mock-ups and for neutron, thermal, and mechanical control. (France)

1569 ACTIVATION OF CORROSION PRODUCTS BY EPITHERMAL NEUTRONS IN PRESSURIZED WATER REACTORS. Miterev, A. M.; Kasperovich, A. I.; Bychkov, N. V. At. Energ. (USSR); 31: No. 3, 281-3(Sep 1971). (In Russian).

The activation of corrosion products by epithermal neutrons was studied, basing the calculations on a stainless steel loop in a pressurized water reactor: ^{51}Cr, ^{55}Fe, ^{59}Fe, ^{60}Co, ^{54}Mn, and ^{58}Co. The ratio of activity of these isotopes to the activity allowing for solely thermal neutron activation is tabulated. For these same isotopes fast neutron activation has little effect whereas activation by neutrons with resonance energies will significantly raise the total activity of ^{59}Fe and ^{60}Co. Fast neutrons are responsible for producing ^{58}Co and ^{54}Mn. (K.S.W.)

1570 NUCLEAR THERMOELECTRIC POWER PLANT. Magladry, Robert E. (to Teledyne, Inc.). U. S. Patent 3,598,652. 10 Aug 1971. Filed 18 Nov 1965.

The employment of a low pressure vaporizable liquid such as tetraphosphorus trisulfide within the primary loop of a nuclear powered thermoelectric converter to prevent high intensity radiation reaching the thermoelectric conversion unit is described. (auth)

Fuels

Refer also to abstract 467.

1571 (CONF-710414–11) FUEL DESIGN FOR THE AI LMFBR DEMONSTRATION PLANT. Bernath, L.; Wolfe, W. B. (Atomics International, Canoga Park, Calif.). [nd]. 12p. Dep. NTIS.

From Conference on fast reactor fuel element technology; New Orleans, La. (13 Apr 1971).

World-wide experience in the irradiation of stainless steel-clad mixed-oxide fuel rods for Liquid Metal Fast Breeder Reactors (LMFBR) is briefly reviewed. Basic features of a fuel rod design for a LMFBR demonstration plant are described with a brief indication of the basis of selection. (H.D.R.)

1572 (GEAP-10403) AXIAL EXPANSION OF MIXED-OXIDE FUEL MEASURED IN-PILE. Cantley, D. A.; Hull, G. R.; Craig, C. N. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1971. Contract AT(04-3)-189. 65p. Dep. NTIS.

The effect of power changes and burnup on the axial length of a $(Pu_{0.25}, U_{0.75})O_{1.98}$ fuel column irradiated at power levels between 5 and 17 kW/ft to burnups of 44,000 MWd/Te were measured in

reactor as a continuous function of time. The expansion of the fuel was always less than the value computed based on fuel center temperature. After the as-fabricated fuel-cladding gap was closed (after a burnup of ~20,000 MWd/Te) the measurements of fuel column expansion were erratic and unpredictable. 10 references. (auth)

1573 (GEAP-13730) EFFECT OF STOICHIOMETRY ON THE BEHAVIOR OF MIXED-OXIDE FUEL DURING EXTENDED OPERATION IN FAILED PINS. Murata, R. E.; Craig, C. N.; Pfefferlen, H. C.; Novak, P. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1971. Contract AT-(04-3)-189. 52p. Dep. NTIS.

Two mixed-oxide fuel pin sections containing fuel of 1.95 and 1.99 O/M were purposely defected and irradiated to an average burnup of 8700 MWd/Te in a flowing sodium environment. Stoichiometry was a sensitive parameter in this experiment. The pin section containing 1.99 O/M fuel sustained a total volumetric increase of 21% compared to 10% for the 1.95 O/M fuel section. Average peak diametral changes in the 1.99 and 1.95 O/M fuel pin sections were, respectively, 7% and 23%. Analysis suggests that in a reactor where the oxygen content of the sodium is maintained at a low value, the extent of sodium-fuel reaction and consequent swelling would be smaller. Less than 1% of the fuel was lost from either section. 11 references. (auth)

1574 (HPR-138) FINAL REPORT ON BURN-OUT ASSEMBLY IFA-40. Hanevik, A. (ed.) (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Jun 1971. 50p. Dep. NTIS (U. S. Sales Only).

Burn-out and instability measurements were performed in-pile on a 7-rod fuel cluster. The burn-out experiments were made at two system pressures and over a wide range of channel powers. The channel stability was studied at two system pressures and at different degrees of inlet throttling. The results generally agreed with the expected behavior. The post-irradiation examination revealed sunburst failure in one of the rods. The 33 approaches to burn-out have resulted in a corrosion rate a factor 2 larger than normally encountered in the HBWR. 11 references. (auth)

1575 (TID-25847) LMFBR FUEL RECYCLE IN THE UNITED STATES: AN ELEMENTARY OVERVIEW. Wymer, R. G. (Oak Ridge National Lab., Tenn.). [1971]. 26p. Dep. NTIS.

Estimates of the fuel reprocessing loads based on projected Liquid Metal Fast Breeder Reactor installations in the United States are presented. The fuel fission product content, shipping, processing operations, refabrication, and processing plant off-gas treatment are briefly discussed. (H.D.R.)

1576 DOUBLING TIME OF FAST REACTORS: HOW LONG IT SHOULD BE. Orlov, V. V. At. Energ. (USSR); 31: No. 3, 195-7(Sep 1971). (In Russian).

Estimates of natural uranium requirements for the developing nuclear power economy based on light water reactors and fast breeders are given in comparison with known world resources of relatively cheap natural uranium. This comparison shows that the use of fast reactors with doubling time $T_2 = 6 + 8$ years makes it possible to develop large-scale nuclear power economy within the limits of cheap uranium resources to provide the fuel for nuclear power economy from its own resources in perspective. It is stressed that LMFBR and their fuel cycle modifications, which are being developed achieve these characteristics. 4 references. (auth)

1577 FUEL PIN VARIANTS WITH CARBIDE FUEL FOR A HIGH GAIN BREEDER. Plitz, Helmuth; Fiedler, Helmut (AEG-Kernenergieversuchsanlage, Grosswelzheim, Ger.). At. Strom; 17: No. 7-9, 130-3(Jul-Sep 1971). (In German).

In a high gain breeder the nuclear fuel (U, Pu)C replacing (U, Pu)O_2 offers advantages in regard to breeding rate and fuel cycle costs. The problems with carbide and possible fuel pin concepts are investigated. The pin concept with carbide fuel, sodium-bonding and venting is economically attractive and seems to be practicable with respect to irradiation experiences. (6 references) (auth)

Auxiliary and Emergency Systems

Refer also to abstract 372.

1578 (ORNL-TM-3524) OPERATION OF THE SAMPLER-ENRICHER IN THE MOLTEN SALT REACTOR EXPERIMENT. Gallaher, R. B. (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 40p. Dep. NTIS.

The sampler-enricher for the Molten-Salt Reactor experiment was designed to remove 10-g samples and to add 90-g increments of uranium to the pump bowl. During the five-year service life the equipment was used to isolate 593 samples and to make 152 fuel additions. It was still operable when the reactor was shut down. The major maintenance jobs involved the manipulator boots and the capsule drive unit. The boots were changed 17 times. The drive unit was replaced once and repaired four other times. There were some minor repairs. No excessive release of gaseous or particulate matter occurred during operation or maintenance of the equipment. 14 references. (auth)

1579 NUCLEAR REACTOR OFF-GAS BURNER SYSTEM. Hartman, William A. Jr.; Siegler, Manny (to General Electric Co.). U. S. Patent 3,598,699. 10 Aug 1971. Filed 9 Apr 1969.

A system for burning flammable gas in the off-gas from a nuclear reactor power plant is disclosed. The system includes three porous plugs in series in the off-gas line. The first plug serves as an upstream flame arrestor in case of burner failure. The second porous plug serves as a burner with a flame ignition means adjacent the downstream face of the plug. The third porous plug serves as a downstream flame arrestor and condenser for the water vapor formed in the flame reaction. Each of the porous plugs includes internal cooling means to remove heat. Appropriate temperature sensing means and control means are provided to insure safe, reliable operation. (auth)

Operation and Economics

Refer also to abstract 1633.

1580 (ANL-EBR-43) LOADING DIAGRAMS OF EXPERIMENTAL SUBASSEMBLIES STARTING IRRADIATION IN EBR-II RUNS 43-50. EBR-II Project. Case, J. C. (comp.) (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Aug 1971. Contract W-31-109-eng-38. 69p. Dep. NTIS.

The loading diagrams for all experimental subassemblies as they were fabricated for irradiation starting in EBR-II runs 43 through 50 are presented. Each diagram, with its accompanying table, gives the location, identification number, and content of each capsule (or element) in the subassembly. Each diagram shows the direction to the EBR-II core center at the time of the initial loading of the subassembly into the reactor grid. Information with each diagram gives the type of hardware, orifice size, results of flow-testing of the fabricated assembly, date and place of assembly, and date placed into the reactor. (auth)

1581 (GULF-GA-B-10757) SOME LOADING SCHEMES FOR MIXED RECYCLE AND NON-RECYCLE FUEL. Asmussen, K. E.; Brogli, R. H. (Gulf General Atomic Co., San Diego, Calif.). 23 Aug 1971. Contract AT(04-3)-167. 63p. Dep. NTIS.

The reference HTGR fuel cycle includes a period of several reloads during which there is a transition from using only fully enriched makeup feed (i.e., ~93% ^{235}U) to the use of a combination of recycled uranium (^{233}U) plus makeup. It is obviously desirable to realize a smooth transition to the recycle mode of operation. The concern for a smooth transition arises due to the fact that ^{233}U and ^{235}U behave significantly differently as a nuclear fuel as a result of their differing cross section behavior. The power distribution has been found to be very sensitive to the fission and absorption cross sections. Different methods of distributing the fuel and poison were studied which will result in a transition to the recycle mode of operation without significantly perturbing the desired power distribution. (auth)

1582 NUCLEAR AND FOSSIL-FUELED PLANTS COMPARED. Broderick, James R.; Zodiaco, Vincent P. (Pennsylvania State Univ., University Park). Pub. Util. Fortn.; 88: No. 5, 30-5(2 Sep 1971).

Operating costs in the U.S. for nuclear power plants and steam power plants are compared. (D.C.C.)

1583 METHODOLOGICAL BASE OF NUCLEAR POWER ECONOMY DEVELOPMENT FORECAST. Dollezhal, N. A.; Melent'ev, L. A.; Baturov, B. B.; Koryakin, Yu. I.; Chernavskii, S. Ya. At. Energ. (USSR); 31: No. 3, 187-94(Sep 1971). (In Russian).

A short analysis of the large power systems is given. In forecasting the nuclear power economy development the dynamics of development of total power and electrical power systems must be taken into account. Intrinsic properties of the nuclear power economy significantly determining forecast technique are analysed. The methodological approaches to choose the calculated time depth of the forecast are discussed. The effect of available methods on the forecast time depth is determined. A complex of mathematical models forming a hierarchical structure is suggested as a basis. The model of the first hierarchical level designed for the choice of the optimum direction of nuclear power

economy development for a long period is described. The linear programming is used. The minimum of listed costs is discussed as one of the possible optimization criteria. 4 references. (auth)

1584 CONTRIBUTION OF THE CEA TO THE SL1 REACTOR EMERGENCY REPAIRS AFTER THE ACCIDENT ON OCTOBER 17, 1969. Bull. Inform. Sci. Tech. (Paris); No. 157, 3-11 (Mar 1971). (In French).

After the accident in the Saint-Laurent 1 power reactor, where five fuel elements were destroyed, the E.D.F. power station asked for C.E.A. assistance in several fields: problems involved with the work in contaminated zones; various metallurgical and physical problems bound to the presence of uranium; dust filtration; devices for burst slug detection in a polluted core; various chemical and physical analyses; and use of special test facilities. (France)

1585 MULTI-PURPOSE RESEARCH REACTOR (MZFR) AS IT IS TODAY. Eitz, August-Wilhelm (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.); Rauber, Alfons. At. Strom; 17: No. 7-9, 124-9(Jul-Sep 1971). (In German).

The MZFR is the first nuclear power station which was developed in Germany. After considerable operational difficulties in the first years after it was taken over in the year 1966, excellent operational results were achieved from October 1969. In 1970 the utilization was 86% and in the last 12 months 98%. The losses of heavy water decreased continuously and are lower than the guaranteed figure of less than 1% per annum. The behavior of the fuel elements was and is excellent: less than 0.1% of the rods inserted became defective. (8 references) (auth)

Safety and Siting

Refer also to abstracts 411-413.

1586 (AI-AEC-12818, pp 5-14) NUCLEAR SAFETY (KINETICS): BOILING STUDIES FOR SODIUM REACTOR SAFETY. Logan, D.; Landoni, J.; Baroczy, C. (Atomics International, Canoga Park, Calif.). Jan-Mar 1969.

In AEC unclassified programs.

Basic information on two-phase flow and boiling required in the safety evaluation of LMFBR designs is presented. The measurements of boiling heat transfer characteristics, two-phase pressure drop, void fraction, liquid superheating, transient voiding rates and pressures in single channels, and hydrodynamic instabilities are described. A total of 230 sodium liquid superheat test runs were completed for test conditions of 5 to 15 psia pressure and for fluid velocities of 4 to 9 ft/sec. (auth)

1587 (AI-AEC-12860, pp 5-21) NUCLEAR SAFETY (KINETICS): BOILING STUDIES FOR SODIUM REACTOR SAFETY. Logan, D.; Landoni, J.; Baroczy, C. (Atomics International, Canoga Park, Calif.). 1969.

In AEC unclassified programs.

Basic information on two-phase flow and boiling required in the safety evaluation of LMFBR designs is presented. The measurements of boiling heat transfer characteristics, two-phase pressure drop, void fraction, liquid superheating, transient voiding rates and pressures in single channels, and hydrodynamic instabilities are described. Successful completion of 356 transient boiling tests to obtain data on superheating of liquid sodium is reviewed. (auth)

1588 (AI-AEC-12887, pp 5-19) NUCLEAR SAFETY (KINETICS:): BOILING STUDIES FOR SODIUM REACTOR SAFETY. Logan, D.; Landoni, J.; Baroczy, C. (Atomics International, Canoga Park, Calif.). Jul-Sep 1969.

In AEC unclassified programs.

Basic information on two-phase flow and boiling required in the safety evaluation of LMFBR designs is presented. The measurements of boiling heat transfer characteristics, two-phase pressure drop, void fraction, liquid superheating, transient voiding rates and pressures in single channels, and hydrodynamic instabilities are described. A total of 374 sodium liquid superheat test runs were completed for test conditions of 5 psia and for fluid velocities of 3 to 9 ft/sec. Included were 50 flow coastdown runs in which boiling was initiated by a reduction in flowrate at otherwise fixed conditions. A 30-in. shaped heat flux heater was fabricated and tested to a heat flux of 10^6 Btu/hr-ft^2. A three channel test section flow distributor insert has been fabricated and instrumented in preparation for the three channel experimental program. (auth)

1589 (ANL-7859) POSTACCIDENT HEAT REMOVAL IN LMFBRS: IN-VESSEL CONSIDERATIONS. Hesson, J. C.; Sevy, R. H.; Marciniak, T. J. (Argonne National Lab., Ill.). Sep 1971. Contract W-31-109-eng-38. 95p. Dep. NTIS.

The behavior of fast reactor oxide fuel following a postulated accident which results in a loss of core integrity and effective core cooling surface was analyzed. The studies were directed mainly to the problems of fission-product decay-heat removal from and the retention of the core fuel debris in the reactor vessel. It was assumed that the sodium-coolant system with its supply of sodium and some of the circulation loops remain functional for natural convection and pony-motor circulation after the accident. The core damage and distribution at the end of the hypothetical accident, the decay heat to be removed, and the cooling potential of the sodium circulating through the primary-loop system and reactor vessel by both natural convection and pony-motor forced convection were estimated. The cooling of fuel debris in porous beds outside the core barrel, in the initial core area, in the basket area, and on the reactor-vessel bottom head is discussed. The potential formation of a molten pool of fuel debris in the core area and the time for it to melt through to the basket area, as well as retention on the bottom core-support plate by subcooled-sodium cooling of the support plate, are analyzed. It is concluded that the FFTF reactor has a good potential for retaining the fuel debris in the reactor vessel in the event of a core meltdown accident. 21 references. (auth)

1590 (CONF-711111-2) RELIABILITY METHODS APPLIED TO REACTOR SAFETY: TRENDS AND PROGRESS. Rubel, P. (Oak Ridge National Lab., Tenn.). 7 Sep 1971. 14p. Dep. NTIS.

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971).

The main roles of reliability engineering methods in reactor safety are to improve the design of protection systems and enhance quality assurance. The continuing efforts to strengthen the credibility of probabilistic safety evaluations and to expand the analysis role in guiding safety support activities are reviewed. A trend toward situation-oriented analysis is noted, along with innovations in exploiting the limited information available for analysis input. (14 references) (auth)

1591 (JAERI-Memo-4444) REPORT ON THE NUCLEAR SAFETY EXPERIMENTAL PROGRAM, NO. 5. Ishikawa, Hiroshi; Shimamune, Kohji; Ishikawa, Michio; Tomii, Kakuzo; Nakahara, Yasuaki (Japan Atomic Energy Research Inst., Tokyo). May 1971. 84p. (In Japanese). Dep. NTIS (U. S. Sales Only).

Studies in the NSRR program for the period of October 1970 to March 1971 are summarized. Contents of the report are; (1) Summary of progress in the fifth period; (2) Design study on NSRR facilities and experiments; (3) Physics calculation on the NSRR core; (4) Safety evaluations; (5) Pre-analysis for the experiments; (6) Investigation on fast reactor safety in the NSRR program; (7) Investigation on light water power reactor safety in the NSRR program. (auth) (Japan)

1592 (RT/ING-70(3)) POWER TRANSIENTS IN A SODIUM COOLED FAST REACTOR. Tavoni, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 27p. (In Italian). INIS.

With reference to the safety analysis of the PCC power fast reactor, some typical transients due to the insertion of infinite or finite reactivity ramps were considered. The corresponding fuel element conditions were evaluated. The main parameters were related to the inserted reactivity ramp and to time, and were correlated to each other. At last, the insertion of the control rod system with different delay times was considered. (INIS)

1593 (WARD-5446) FISSION GAS EJECTION CHARACTERISTICS AND ITS EFFECT ON ADJACENT FUEL PINS IN A LMFBR. Carelli, Mario D.; Coffield, Ronald D. Jr. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Sep 1970; Revised Feb 1971. Contracts AT(30-1)-4200; AT-(45-1)-2171. 24p. (CONF-710414-13). Dep. NTIS.

From Conference on fast reactor fuel element technology; New Orleans, La. (13 Apr 1971).

The characteristics of fission gas release following an accident leading to the rupture of the fuel pin cladding in Liquid Metal Fast Breeder Reactors are quantitatively examined. The pressure, velocity and mass flow rate of the gas during the transient ejection are reported for a wide range of failure sizes and locations. A model which considers the effect of the fuel pin internal configuration, the effects of gas compressibility and both sonic and subsonic gas flow is described. The effect that the gas jet issuing from the failure has on the adjacent pins is analyzed. The deflection of the jet in the subchannel, the location of its impingement point and the blanketing effect on the adjacent pin are studied. Propagation of failure to the next pin is excluded for very large and very small failure areas. Theoretical possibility of failure of the adjacent pins exists for failure areas in the range of 10^{-4}

to 10^{-5} in.^{2}; extensive failure propagation however does not appear probable. The size of gas bubbles resulting from jet break-up is calculated for various reactor and failure conditions. (18 references) (auth)

1594 POWER GENERATION AND THE ENVIRONMENT. Luce, Charles F. (Consolidated Edison Co., New York). Pub. Util. Fortn.; 88: No. 5, 72-5(2 Sep 1971).

The effects of nuclear power plant and steam power plant operations on the environment are described. Power demands and alternate power sources are discussed. Research and development costs for reducing power plant pollution are analyzed. (D.C.C.)

1595 THERMAL POLLUTION: A POTENTIAL THREAT TO OUR AQUATIC ENVIRONMENT. John, James E. A. (Univ. of Maryland, College Park). Environ. Aff.; 1: No. 2, 287-98 (Jun 1971).

The effects of reactor site selection and control methods for thermal effluents on ecosystems are discussed. Potential uses of power reactor thermal effluents are described. 7 references. (D.C.C.)

1596 NUCLEAR REACTOR SAFETY: AN EVALUATION OF NEW EVIDENCE. Forbes, Ian A.; Ford, Daniel F.; Kendall, Henry W.; MacKenzie, James J. Nuclear News; 14: No. 9, 32-7; 40(Sep 1971).

The consequences of a coolant loss accident in a power reactor that releases a substantial amount of radioactive material into the environment are described. The possibility of fission product releases occurring through the failure of engineered safeguards is analyzed. (D.C.C.)

1597 NUCLEAR POWER PLANTS: A RISK FOR THE ENVIRONMENT. Schwarzer, Wolfgang (Institut fuer Reaktorsicherheit, Cologne). At. Strom; 17: No. 7-9, 118-21(Jul-Sep 1971). (In German).

The risk involved in the emission of radioactive substances with nuclear electricity generation is related to the natural radioactivity. Taking the light-water reactors as an example, it is shown how technical and testing expenditure is able to avoid disturbances and/or to reduce their effects to such a degree that nuclear power plants maintain the highest safety factor. (3 references) (auth)

Power Conversion Systems

1598 UNDERSTAND HOW STEAM GENERATION IS REGULATED IN NUCLEAR CENTRAL STATIONS. Stevens, Howard (Babcock and Wilcox Co., Lynchburg, Va.). Power; 115: No. 9, 100-1(Sep 1971).

Boilers used in pressurized-water power reactors are described. Operating characteristics of typical control and protection systems are presented. (D.C.C.)

Research and Test Reactors

Refer also to abstract 449.

1599 (AECL-3998) BUCKLINGS OF HEAVY WATER MODERATED LATTICES OF ZEEP RODS. McDonnell, F. N.; Okazaki, A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1971. 18p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

The bucklings of heavy water moderated lattices of ZEEP rods (3.25 cm diameter natural U metal contained in aluminum tubes) were measured by the flux mapping method in the ZED-2 reactor. The isotopic composition of the moderator was 99.46 atom percent D_2O. The bucklings, corrected for the 0.34 atom percent difference in isotopic composition, are in excellent agreement with earlier measurements made in the ZEEP reactor. (auth)

1600 (ANCR-1013) REACTOR TECHNOLOGY BRANCH ANNUAL REPORT, FISCAL YEAR 1970. Burdick, E. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Aug 1971. Contract AT-(10-1)-1375. 44p. Dep. NTIS.

Activities reported contain highlights from studies on ATR hafnium burnup, poison buildup in ATR and ETR beryllium reflectors, ATR power coefficient, ATR excess reactivity as a function of power-time, ATR noise measurements, xenon axial stability in ATR, ATR reactor transfer function, boron assaying ATR 7F Elements, ATRC lobe power monitoring system, ETRC fission rate errors, reactivity effects and flux effects due to flux wire holders and boron wands, ETR-ETRC power distribution comparison, and reactor simulation. (auth)

1601 (BARC/I-92) OPTIMISATION STUDIES TO FIND MINIMUM BULK SHIELD FOR APSARA REACTOR CORE TO INCREASE AVAILABLE BEAM HOLE NEUTRON FLUX. Sankaranarayanan, S.; Narain, Rajendra; Sen Gupta, S. N. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 36p. INIS.

A relatively simple analysis regarding shielding studies for Apsara reactor core is presented. Details of a computer code SHIELD based on this are given. It is shown that the present 12½ feet shield thickness consisting of water and ordinary concrete can be replaced by about 5 feet shield thickness comprising of water, iron and lead. By this approach the available neutron fluxes at the experimental beam hole faces can be enhanced without increasing the reactor power. (auth) (INIS)

1602 (BARC/I-107) MELTDOWN ACCIDENT ANALYSIS OF FAST CRITICAL FACILITY. Garg, S. B. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 21p. INIS.

A parametric study of the meltdown accident analysis of Fast Critical Facility was conducted to estimate the maximum energy available to perform the destructive work upon the containment structure during the fuel expansion. The various parameters considered are (1) rate of reactivity insertion, (2) initial power level, (3) Doppler reactivity coefficient, (4) prompt neutron life time, and (5) spatial power distribution. A two phase logarithmic form of the equation of state connecting the pressure and the energy of plutonium oxide fuel was set up. The energy release calculations were carried out in spherical geometry by taking into account the delayed neutron data. (auth) (INIS)

1603 (CONF-710301-(Vol.1), pp 140-6) SENSITIVITY OF A PLUTONIUM-FUELED BURNUP EXPERIMENT TO MICROSCOPIC CROSS SECTION DATA. Jenquin, U. P. (Battelle-Northwest, Richland, Wash. [Pacific Northwest Lab.]).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A burnup experiment was performed in the Materials Testing Reactor with an all plutonium core. The measured lifetime of the core is substantially different from the predicted lifetime. The discrepancy is due primarily to the difference between the measured and calculated burnup slope. Calculations were made to determine the sensitivity of the burnup slope to basic cross section data such as $^{239}\alpha$, $^{240}\sigma_a$, and the scattering kernel for H_2O. The analyses show that the uncertainties in these basic parameters account for only a small part of the discrepancy. The calculated burnup slope is very sensitive to the cross sections of nonsaturating fission products. Moreover, most of the neutron absorptions in nonsaturating fission product nuclei occur at energies greater than 1 eV where the fission product cross sections are less accurately known. Therefore, improvements in the knowledge of the cross sections of nonsaturating fission products are important in the development of improved design technology for plutonium-fueled thermal reactors. 18 references. (auth)

1604 (DOCKET-50231-100) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Reactor Vessel Main Flange Structural Evaluation. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). 29 Oct 1971. 40p. Dep. NTIS.

1605 (DOCKET-50231-101) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Safety System Relay Malfunction, October 17, 1971. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 5 Nov 1971. 4p. Dep. NTIS.

1606 (INIS-mf-114) REACTOR RESEARCH CENTRE, KALPAKKAM, FAST BREEDER TEST REACTOR. (Department of Atomic Energy, Bombay (India)). 1970. 3p. INIS.

The advantages of using fast breeder reactors, particularly in India, as against the thermal ones, for the utilization of fertile materials, are outlined. The need for using a coolant other than water is explained. The fast breeder test reactor at Kalpakkam will use a mixture of plutonium oxide and uranium oxide as fuel and liquid sodium as coolant. The power produced will be 50 MW thermal. The steam generated at 480°C and 124 atmospheres pressure will be utilized to run a turbo-generator and will produce 15 MW of electric power. The part played by the CEA of France and the Indian engineers receiving training at their establishment is dwelt upon. The role of the Indian industry in the launching of the first breeder reactor project is emphasized. The great use to which the Reactor Research Center at Kalpakkam can be put by the various research personnel attached to it is pointed out. The pulsed fast reactor, situated at the same site, is described, with particular reference to the wide scope of fundamental studies which can be carried out there. The contribution from the BARC technical personnel in the design and development of the pulsed fast reactor is mentioned. The possibility of this center becoming a stimulating research program center for the neighbor-

ing educational centers, after it becomes operational in 1973, is discussed. (INIS)

1607 (KFK-EXT-8/70-2) DISTURBANCE CONSIDERATIONS FOR MZFR-D_2O-LOOP. ANALOG COMPUTER MODEL AND INVESTIGATION OF THE DYNAMIC BEHAVIOR OF A CARBIDE IRRADIATION RIG IN EMERGENCY COOLING. Fiege, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jul 1970. 32p. (In German). INIS.

Within the studies of incidents made for the preliminary safety report on the D_2O loop of the Multipurpose Research Reactor (MZFR) the dynamic behavior of a test rig for carbide fuel (UC/PuC) irradiations was examined with an analog computation model for the main incidents possible. The results shown as temperature curves are preliminary information based on estimated curves for coolant throughput and system pressure which have to be checked upon the termination of a planned out-of-pile test of the aggregate assembly. Previous results show that the loop designed to irradiate a representative 2 MW oxide fuel rig (maximum rod power 800 W/cm) can be operated without modifications with a carbide fuel rig of the same power level (maximum rod power 1500 W/cm). (INIS)

1608 (ORNL-TM-3542) DETERMINATION OF THE FAST NEUTRON FLUX AND SPECTRUM IN THE OAK RIDGE BULK SHIELDING REACTOR WITH APPLICATION TO RADIATION DAMAGE EXPERIMENTS. Jenkins, T. D. (Oak Ridge National Lab., Tenn.). Nov 1971. Contract W-7405-eng-26. 42p. Dep.

The fast neutron flux level and energy spectrum in the liquid nitrogen cryostat facility located at the north face of the Oak Ridge Bulk Shielding Reactor were determined by the multiple foil activation technique and by calculation. Good agreement is obtained between the calculated and experimentally determined flux. The ratio of the integral fluxes above energy E given by calculation and experiment differ by less than 10% over the energy range from 1.86 eV to 10 MeV. In the course of the calculations a method was developed to utilize two-dimensional multigroup-transport calculations in a restricted area of the reactor core and simulate the rest of the reactor with appropriate boundary conditions. Calculated results using this technique gave better agreement with experiment than was obtained using one-dimensional transport calculations. The spectrum so deduced was used to calculate relative radiation damage rates to beryllium. In addition, the calculational techniques verified by the detailed dosimetry experiment were used with confidence for the design of an alternate experimental facility and for the interpretation of data accumulated in it. (23 references) (auth)

1609 (ORNL-TM-3596) MONTE CARLO ANALYSIS OF THE EXACT GEOMETRIC MOCKUP OF ZPR-III ASSEMBLY 48. Cramer, S. N. (Oak Ridge National Lab., Tenn.). 13 Oct 1971. 41p. Dep. NTIS.

The ZPR-III Assembly 48 was described in full geometric detail in a series of Monte Carlo eigenvalue calculations using the ESP code. An array version of the generalized geometry package and the many "fine group" energy structure of this code combine to allow a direct application of the "fictitious scattering" transport model to this calculation. Use of this model provides rapid evaluation of the neutron trajectories across the many thin plates of the assembly core. However, the explicit description of each plate type creates difficulty in establishing the correct weighting functions in the resonance energy cross-section calculations. For this reason, special attention was given to the unresolved resonance cross-section evaluation for ^{239}Pu and ^{238}U. This geometric and cross-section detail, together with the modified ENDF/B II data, gives a value of $k_{eff} = 0.997 \pm 0.005$ for the assembly. (8 references) (auth)

1610 (RT/FI-70(16)) UTILIZATION OF AN ON-LINE DIGITAL COMPUTER FOR EXPERIMENTS OF NUCLEAR REACTOR PHYSICS. Ferrari, T.; Martinelli, R.; Pacilio, N.; Valent, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 54p. (In Italian). INIS.

A small digital computer (PDP-8, 12-bit word, 4K-word memory) is being used for on-line data collection and reduction and analysis and control of some critical facilities at C.S.N. Casaccia in five reactor-physics procedures. They concern: (1) relative measurements of absorption cross-sections via oscillating samples; (2) statistical analysis of nuclear detection processes; (3) reactor-noise-time analysis methods for prompt-neutron lifetime and reactivity measurements in reactor systems; (4) pulsed-neutron experiments; and (5) reactor stable-period experimental determination. (INIS)

1611 (RT/ING-70(4)) CRITICAL EXPERIMENT REACTOR FOR "ENRICO FERMI" NUCLEAR SHIP. Albergamo, V.; Santandrea, E.; Villani, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 17p. (In Italian). INIS.

At the Casaccia Nuclear Research Center the reactor which had been in operation since 1963 under the name of Rospo was adapted for use in the Ship Propulsion Program. To this end several changes were introduced, making the reactor suitable for testing PWR-type cores. (INIS)

1612 (SGAE-R-4/1970) MEASUREMENTS AT THE BERYLLIUM REFLECTED ASTRA CORE. Burtscher, A. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Feb 1970. 13p. (In German). INIS.

The results of measurements at the ASTRA core after the installation of a beryllium metal reflector are summarized. The measurements include the influence of the beryllium with respect to the excess reactivity. The neutron level in the shutdown condition and thermal and fast neutron flux measurements at the reflector face and in the neutron beams of the beam tubes are discussed. (auth) (INIS)

1613 (SGAE-R-5/1970) REACTIVITY MEASUREMENTS AT THE ASTRA CORE AFTER INSTALLATION OF A BERYLLIUM REFLECTOR. Nedelik, A.; Gruenwald, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Sep 1970. 11p. (In German). INIS.

Replacing of the graphite-reflector by metallic beryllium-elements caused an essential increase of photoneutron-density in the subcritical reactor. A series of simple measurements showed that the influence on period measurements is negligible provided the power level is chosen properly. Comparative measurements were made in water- and beryllium-reflected cores to check the relative shape of the inhour-curve. Calibration in absolute reactivity units was obtained by using the xenon-poisoning of the core. (INIS)

1614 (UJV-2478-R) DOSE RATE AT THE POOL LEVEL OF A MATERIALS TESTING REACTOR. Stoces, B.; Burian, J.; Rataj, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Oct 1970. 10p. (In Czech). INIS.

Brief data are given on French pool-type reactors. The data are needed for an accurate calculation of water activity and the determination of the variation of dose rate with depth of pure water. They were applied in similar calculations of the Czechoslovak materials testing reactor; some results are given in tables. (INIS)

1615 (UJV-2495-R) MAXIMUM VALUES OF LIMITING QUANTITIES IN THE FUEL CHANNEL OF A MATERIALS TESTING REACTOR. Novotny, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 36p. (In Czech). INIS.

A calculation is presented of the maximum values of quantities which limit the output of the fuel assembly of a materials testing reactor: the maximum permissible temperature of the fuel element cladding with respect to its strength, the outlet temperature of cooling water with respect to a possible local boiling of the liquid in the pool, and the overpressure of coolant at the channel inlet with respect to the strength of the separating tube wall. Expressions are also derived for the indeterminancy factors of the limiting quantities. (INIS)

1616 (UJV-2500-R) PRELIMINARY SAFETY REPORT FOR THE EXPERIMENTAL EQUIPMENT OF A MATERIALS TESTING REACTOR. Zbehlik, J.; Masarik, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Sep 1970. 35p. (In Czech). INIS.

Operating safety of the experimental equipment of a materials testing reactor is discussed, and a method of detailed treatment of safety problems is suggested. The operation program and normal performance of individual devices are described (the water loop, the gas loop, the sodium loop, and the irradiation probes). Possible accidents of the loops are considered, and a fuel element failure is analyzed in more detail. For the individual loops, methods to calculate post-accident activities are given. (INIS)

1617 (UJV-2531-P) INFORMATION AND CONTROL SYSTEM FOR IRRADIATION EXPERIMENTS ON A MATERIALS TESTING REACTOR. 1. SPECIFICATION OF REQUIREMENTS. Vavrin, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 48p. (In Czech). INIS.

A description is given of an information and control system for irradiation experiments on a materials testing reactor. Properties of information channels are discussed: the mode of transmission, accuracy, dynamic properties, and performance characteristics. The memory of the system and the way of operating

the system are described and characterized. Attached are results of processing data obtained in irradiation facilities. Requirements are listed for the input and output units, the maximum internal memory (20 to 32 K), the computer memory cycle (3 μs), and the external memory (1.5 to 2 M). (INIS)

1618 (UJV–2535–P) INFORMATION AND CONTROL SYSTEM FOR LOOP EXPERIMENTS IN A MATERIALS TESTING REACTOR. Blazek, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 20p. (In Czech). INIS.

The Czechoslovak MTR will be equipped with three gas loops, one water loop, and one sodium loop. To select the measurement and control system for the reactor, the classical method of performing all measurements and control with analog devices was compared with the method of using three small computers and with that using one medium computer. It was assumed that in the first two cases complex calculations would be performed by a off-line medium computer. The system using three small computers is considered to be best suitable although the total hardware costs without spare parts—estimated at 340,000 dollars—are by 45,000 dollars higher than in the case of using a single medium computer. The difference in cost will be offset by avoiding difficulties when making the system operational and by decreased requirements for the medium computer capacity. (INIS)

1619 (UJV–2536–RT) MTR FUEL ELEMENT TRANSIENT STATES. PART I. BRIEF DESCRIPTION OF THE APPROACH TO THE SOLUTION. Pernica, R. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov 1970. 8p. (In Czech). INIS.

The procedure of calculating time variations of temperature fields in coolant, fuel, and cladding is briefly explained. Also discussed are variations of the flow through the fuel element, and the distribution of produced steam for conditions departing from the steady state. A dynamic model for the given element, i.e., a program for a digital computer, will be prepared. The fundamental equations to be solved are given. (INIS)

1620 (WHAN–SA–109) EVOLUTION: FTR FUEL PIN DESIGN TO PROCUREMENT. Burgess, Carl A.; French, Peter M. (Hanford Engineering Development Lab., Richland, Wash.). [1971]. Contract AT(45-1)-2170. 28p. (CONF-710414–12). Dep. NTIS.

From Conference on fast reactor fuel element technology; New Orleans, La. (13 Apr 1971).

The program for establishment of commercial production resources for the Fast Test Reactor (FTR) driver fuel is summarized. An integrated effort between design and development was maintained throughout the design of the FTR fuel system to assure responsiveness to designer requirements. The evolution from design concept to national fuel standards is described. (15 references) (auth)

1621 MELUSINE REACTOR POWER INCREASE. Marouby, R. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 156, 3–11(Feb 1971). (In French).

The MELUSINE swimming-pool reactor, built in 1958 at the Grenoble Nuclear Center, has been operated successively at 1, 1.4, 2, and 4 MW and since January 1971 at 8 MW. Important transformations were accomplished at the different stages. The modification for the last increase of power to 8 MW essentially consisted in renewing the main cooling circuit. A special heat exchanger of the plate type was used for the first time on the French reactors. This relatively low cost installation was set up in a month. (France)

1622 NEUTRON SPECTRUM FROM A GRAPHITE PILE. Kobayashi, Keiji (Kyoto Univ., Osaka). Nippon Genshiryoku Gakkai Rochuseishi Kenkyu Senmon Iinkai Hokoku; No. 29, 17–25 (Sep 1970). (In Japanese).

When buckling of a system exceeds some value determined from Σ min of the medium, intrinsic attenuation constant disappears. As the Σ min is extremely small in crystalline medium, this phenomenon is important. This problem was investigated by differential measurement of neutron spectra in graphite systems at various distances (Z) from a plane source, and by observing existence of equilibrium spectra. The system was analyzed by two group calculation, in which neutrons were divided into a thermal group above cut-off energy of graphite and a cold group. Flux ϕ_1 of the thermal group was expressed by a diffusion equation, and that of cold group by $\phi_2 = Soe^{-\Sigma tzZ}$. Theoretical ratio of $\phi_2(Z)/\phi_1(Z)$ as a function of distance Z approached to a definite value. The plane neutron source was graphite thermal column of the Research Reactor of Kyoto University. Neutron spectra from a re-entrant hole through an additional graphite pile adjacent to the column were measured with a mechanical monochrometer with helical slits. Spatial variation of flux of the cold neutrons was small, but that of the thermal neutrons was large. The spectra were different from spectrum of thermal column. The ratio of fluxes of thermal and cold neutrons approached to a saturation value, but more slowly than the calculated values. Effect of neutron flow was discussed. (Japan)

1623 SOME FORMULAE FOR THE RADIOISOTOPE FORMATION. I. WHEN A REACTOR IS OPERATED REGULARLY AT A CERTAIN TIME INTERVALS. Lee, Chang Kun; Kim, Taeyoung; Yim, Yung Chang (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 3: No. 3, 148–54(Sep 1971).

Some formulae have been derived for the calculation of the formation of radioisotope when a reactor is operated regularly on a usual on-off pattern. The case of isotope production with the present operation condition of the Korean reactor, which is in operation for 8.2 hours from Monday to Thursday and is not operated on Friday and Sunday but is back in operation on Saturday only for 3.2 hours, is discussed. (6 references) (auth)

1624 FIRST CRITICAL EXPERIMENT OF THE SR-0A REACTOR. Dach, Karel (Skoda Works, Plzen, Poland); Fleischhans, Jiri; Kott, Josef; (and others). Jad. Energ.; 17: No. 8, 264–8(Aug 1971). (In Czech).

The specifications of the zero power research reactor SR-OA are presented. The main principles and aims of the critical experiment, experimental equipment, methods of evaluation and the fundamental results are summarized. 3 references. (auth)

Rocket and Space Reactors

1625 (LA–4783) NUCLEAR SAFETY OF AN AIRBORNE THERMAL REACTOR. Status Report of the Reactor Criticality Analysis Program to October 1, 1971. Vigil, J. C.; Carmichael, B. M.; Best, G. H. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. 11p. Dep. NTIS.

Neutronic calculations were performed to investigate the feasibility of using a diluent-poison to solve the criticality problem arising from core meltdown for the airborne thermal reactor concept. Survey calculations were performed in one-dimensional spherical geometry on both bare and reflected spheres containing diluent: UO_2 core volume ratios of 0.0, 0.5, 1.0, 2.0, and 3.0. Two-dimensional calculations were also performed for one particular diluent in order to obtain an indication of how the one-dimensional results relate to more realistic geometrical configurations. The diluents studied were W, WB, WB_2, Ta, TaB_2, and Re. Both natural boron and ^{10}B were used in the survey calculations for the borides. With the exception of W, the calculations indicate that any of these diluents could be used to solve the criticality problem with diluent: UO_2 volume ratios of 1.7 or less. For W, a volume ratio of 3.0 is required. 8 references. (auth)

1626 (N–71–27697) SHOCK AND VIBRATION TESTS OF A SNAP-8 TURBOALTERNATOR. Stromquist, Andre J.; Hibben, Lawrence; Foley, Robert S. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1971. 27p. (NASA-TM-X-67851). NTIS.

A turboalternator for the SNAP-8 space power system was subjected to the expected vehicle launch vibration and shock loading in accordance with the SNAP-8 environmental specification. Subsequent disassembly and detailed inspection revealed some internal damage but the unit was judged to be operational. (auth) (STAR)

1627 (TID–25829) EXPERIMENTAL INVESTIGATIONS TO SIMULATE THE THERMAL ENVIRONMENT AND FUEL REGION IN NUCLEAR LIGHT BULB REACTORS USING AN R-F RADIANT ENERGY SOURCE. Roman, Ward C.; Jaminet, Jerome F. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1971. 99p. (K–910900–7). Dep. NTIS.

Experiments were conducted to develop test configurations and technology necessary to simulate the thermal environment and fuel region in nuclear light bulb reactors. The test program was conducted using the UARL 1.2-MW r-f induction heater which has 7.8-cm-ID work coils and operates at approximately 5.5 MHz. Several types of models were installed inside the coils to achieve different program objectives. All models were basically cylindrical vortex chambers with highly cooled fused silica peripheral walls and copper end walls. Argon was used to drive the vortexes. R–F power level, chamber pressure and argon flow rate were adjusted to provide the desired r–f plasma discharge test conditions. 25 references. (auth)

1628 (TID–25830) EXPERIMENTS TO SIMULATE HEATING OF THE PROPELLANT IN A NUCLEAR LIGHT BULB ENGINE USING THERMAL RADIATION FROM A D-C ARC RADIANT ENERGY SOURCE. Klein, John F. (United Aircraft Corp.,

East Hartford, Conn. Research Labs.). Sep 1971. 71p. (K-910900-8). Dep. NTIS.

Experiments were conducted to simulate radiant heating of the propellant stream of a nuclear light bulb engine. The primary objective was to obtain high exit temperatures in the simulated propellant stream due to the absorption of large percentages of the incident thermal radiation. A 500-kW d-c was used as the radiant energy source and argon seeded with carbon particles was used to simulate the propellant. Unseeded buffer layers were used to prevent coating of the transparent duct walls. Methods were developed for introducing micron-sized carbon seeds into the central region of a three-stream flow in a rectangular duct to simulate a portion of the propellant stream. In the tests reported, simulated propellant bulk exit temperatures up to 3860°K (6950°R) were achieved. The bulk exit temperatures were determined by a calorimetric technique. The maximum bulk exit temperatures were limited primarily by vaporization of the carbon seeds and the amount of radiation incident on the test section. 16 references. (auth)

1629 (TID-25837) ANALYTICAL STUDIES OF NUCLEAR LIGHT BULB ENGINE RADIANT HEAT TRANSFER AND PERFORMANCE CHARACTERISTICS. Rodgers, Richard J.; Latham, Thomas S.; Bauer, Harold E. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1971. 126p. (K-910900-10). Dep. NTIS.

The analytical studies of nuclear light bulb engine characteristics were divided into two major sections: (1) a continuing analysis of engine operating and transient response characteristics, with an emphasis on engine shutdown; and (2) a detailed study of the radiation heat transfer characteristics of the fuel and buffer-gas regions. Emphasis in the radiation heat transfer calculations was placed on calculations of the spectral distribution of radiated energy emitted from the nuclear fuel region over a wide range of engine power levels and calculations of the effectiveness of seed systems in altering the spectral distribution of radiant energy. 21 references. (auth)

1630 (TID-25838) ANALYTICAL DESIGN STUDIES OF IN-REACTOR TESTS OF A NUCLEAR LIGHT BULB UNIT CELL. Latham, Thomas S.; Bauer, Harold E. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1971. 57p. (K-910900-11). Dep. NTIS.

Analytical design studies were conducted to determine the design characteristics and performance of a small-scale model of a nuclear light bulb unit cell suitable for testing in a nuclear reactor. The test reactor considered was the Nuclear Furnace, a solid-core nuclear rocket fuel element test reactor. The Nuclear Furnace can provide a specific fission power level in the test region ranging from 25 to 40 kW/gm of ^{235}U fuel. The results of the study indicate that a meaningful series of in-reactor demonstration tests of fuel containment, transparent-wall performance, and propellant heating could be conducted using the Nuclear Furnace reactor. Tests conducted with a configuration having reflecting walls and operating at a pressure of 500 atm could result in thermal radiation fluxes corresponding to black-body radiating temperatures ranging from 5800 to 6300°K. Tests could also be conducted to demonstrate that internally cooled transparent walls are capable of withstanding both the nuclear radiation and thermal environments anticipated for a nuclear light bulb engine and that seeded propellant can be heated to exhaust temperatures in the range of 3300 to 3700°K. 14 references. (auth)

1631 PLANNING AND OPTIMIZATION OF A FAST HEAT-PIPE-THERMIONIC-REACTOR. II. Hanke, H. (Univ., Stuttgart). Atomkernenergie; 18: No. 2, 143-50(1971). (In German).

By means of the reflector economy concept and for a given arrangement of fission zone and reflector, an analytical connection can be established between the geometry and reactor power, weight, and cost. Because of this fact, analytical optimization becomes possible. Optimal dimension and, thereby, reactor cost strongly depend on thickness of the reflector whereby radial and axial thickness must be treated separately. If properly constructed, fast thermionic reactors, in spite of high cost of fission material, can compete with thermal thermionic reactors even at small power demands. Fast thermionic reactors may even become more economical than thermal reactors because of their compactness requiring a relatively low weight of shielding. (H.B.G.)

Process Heat and Desalination Reactors

1632 (NP-19019) APPLICATION OF THE THERMAL ENERGY OF A NUCLEAR REACTOR TO IRON ORE REDUCTION. Block, F. R.; Wingen, E. (Technische Hochschule, Aachen (West Germany). Institut fuer Eisenhuettenkunde). [nd]. 14p. Dep. NTIS (U. S. Sales Only).

The use of heat produced in a helium cooled reactor in an iron ore reduction process is described. The process contains an intermediate cycle in which liquid Pb is heated in a closed graphite tube heat exchanger by the helium from the reactor primary cooling circuit. The heated Pb passes on the heat to the iron ore through direct contact. (H.D.R.)

1633 (TNSD-P-215) MULTIPURPOSE USE OF NUCLEAR ENERGY. Aschner, F. S.; Yiftah, S. (Technion-Israel Inst. of Tech., Haifa). Sep 1970. 20p. (CONF-700649-1). INIS.

From eighth plenary world energy conference; Bucharest, Romania (27 June 1970).

The problems of large dual-purpose plants for power generation and sea water desalination are examined. Technical and economic developments since 1966 are discussed with regard to their influence on the relative status of conventional and nuclear plants. The economy-of-size effect which is particularly significant in nuclear installations has led to plans for agro-industrial complexes and other types of nuclear centers. A project of this type for Israel conditions is reviewed. (INIS)

Marine and Portable Power Reactors

1634 (N-71-25783) NUCLEAR POWERED AIR CUSHION VEHICLES FOR TRANSOCEANIC COMMERCE. Rom, Frank E.; Masser, Charles C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1971. 52p. (NASA-TM-X-2293). NTIS.

Large air-cushion vehicles (ACV's) greater than 3620 metric tons (4000 tons) gross weight have the potential for hauling transoceanic cargo at rates in the range of $0.006 to $0.012 per metric ton-kilometer ($0.010 to $0.020/ton-n mi) at speeds of 185 kilometers per hour (100 knots). It theoretically would take a fleet of over 1000 10,000-metric-ton-gross-weight ACV's to handle 10 percent of the world transoceanic trade projected for 1985. ACV's using compact lightweight nuclear reactors show clearly superior performance for ranges of 3710 kilometers (2000 n mi) or greater. For a range of 7420 kilometers (4000 n mi) the total operating cost for chemical ACV's is three times that for nuclear ACV's. The nuclear ACV performance is less sensitive than the chemical ACV to the operating and cost assumptions used. Relatively large variations in any of the important assumptions had a relatively small effect on nuclear ACV performance. (auth) (STAR)

Production Reactors

1635 (DUN-SA-178) 304 STAINLESS STEEL STEAM GENERATOR TUBE EXPERIENCE AT N-REACTOR. Kratzer, W. K. (Douglas United Nuclear, Inc., Richland, Wash.). 7 Sep 1971. Contract AT(45-1)-1857. 14p. Dep. NTIS.

The Hanford N Reactor was constructed with ten steam generators with Type 304 stainless steel tubes. The causes and extent of stress corrosion cracking problems with these tubes are analyzed. (H.D.R.)

Reactor Theory

1636 (BARC/I-83) AECLHEX AND BARCSQRE: TWO COMPUTER CODES FOR LOADING STUDIES IN THERMAL REACTOR OPERATIONS. Sankaranarayanan, S.; Paul, O. P. K. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 54p. INIS.

The various input and output details are described for two ALGOL programs AECLHEX (for hexagonal mesh geometry) and BARCSQRE (for square mesh geometry) that are being used for nuclear reactor operations at the Bhabha Atomic Research Center, Trombay. The code AECLHEX is an adapted version of the computer code APHEX originally written in APEX language for the Bendix G-20 computer at CRNL, Ontario, Canada. The code BARCSQRE is a modification of AECLHEX to suit square mesh geometries. Both the codes are usable with the CDC-3600 computer at the Tata Institute of Fundamental Research, Bombay, India. (auth) (INIS)

1637 (CONF-710301-(Vol.1), pp 1-24) CRITICAL EXPERIMENTS AND SPECTRUM MEASUREMENTS ON THE VALIDITY OF MICROSCOPIC DATA. Pendlebury, E. D. (Atomic Weapons Research Establishment, Aldermaston (England)).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The accuracies of many microscopic cross section measurements are at best, barely adequate for the accurate calculation of reactor properties, and the degree of sophistication required in neutronics calculations in general is not always obvious. It is therefore essential to check as far as possible, that the microscopic data and the methods of calculation used in reactor design studies and other neutronics calculations will give predictions to adequate accuracy. To this end, integral results, such as experimental critical sizes, spectrum and reaction rate measurements in zero energy reactor systems and simple source driven systems, play an important part. The ways in which the various integral results are used to validate the microscopic data and some of the problems involved are discussed. 31 references. (auth)

Kinetics

Refer also to abstracts 1146, 1149, 1179, 1246, and 1672.

1638 (BARC/I-96) REEVALUATION ON SOME OF THE GROUP CROSS SECTIONS OF INTEREST FOR FAST REACTORS. Kapil, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 22p. INIS.

Group cross-sections of interest in fast reactor calculations are evaluated in view of measurements and analyses of measured data. Group structure of ABBN cross-section set is used and energy range from 10 MeV to 1 keV is covered. Group values are evaluated for two different weighting spectra. (auth) (INIS)

1639 (CONF-710301-(Vol.1)) PROCEEDINGS OF THE THIRD CONFERENCE ON NEUTRON CROSS SECTIONS AND TECHNOLOGY, MARCH 15-17, 1971 AT UNIVERSITY OF TENNESSEE. (Oak Ridge National Lab., Tenn.). Aug 1971. 498p. Dep. NTIS.

Included are 60 papers on the evaluation and application of neutron cross sections. A separate abstract was prepared for each of 54 papers. Six papers were previously abstracted for NSA and may be located under RPI-328-219 and CONF-710301 in the Report Number Index. (H.D.R.)

For abstracts of individual papers see: 1129-1137, 1168, 1200-1209, 1245-1262, 1362-1364, 1563, 1603, 1637, and 1640-1649.

1640 (CONF-710301-(Vol.1), pp 25-31) STUDY OF METHODS OF CROSS-SECTION ERROR IDENTIFICATION UTILIZING INTEGRAL DATA FROM FAST CRITICAL ASSEMBLIES. Ott, K. O.; Pond, R. B.; Kallfelz, J. M. (Argonne National Lab., Ill. Georgia Inst. of Tech., Atlanta).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The different philosophies on the utilization of integral data to test and improve differential cross sections are discussed. Various adjustment procedures, including those of earlier works and several new versions, are systematically investigated. A series of special one-group, space-independent calculations were performed, and the results for the different procedures for several groups of 10-50 critical assemblies are discussed with a numerical comparison for an illustrative case. In this study particular attention was paid to the dependence of the quality of the cross-section adjustments on the assumed accuracy of the integral and differential data, considering the assumed statistical and systematic errors separately. The results are summarized and conclusions are drawn about the possibilities and limits of data adjustment on the levels of this investigation. 15 references. (auth)

1641 (CONF-710301-(Vol.1), pp 32-43) PROGRESS IN MEETING CROSS SECTION NEEDS FROM A FAST-REACTOR DESIGNER'S VIEW. Little, W. W.; Hardie, R. W.; O'Dell, L. D. (Hanford Engineering Development Lab., Richland, Wash.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

An outline is given of the cross section requirements for the design and operation of fast breeder reactors. Progress toward meeting these requirements is then assessed by comparing calculated and experimental results from recent plutonium fueled fast critical assemblies. Finally, the results of selected sensitivity studies are given to permit the demands on integral reactor quantities to be translated into demands on individual cross sections. 11 references. (auth)

1642 (CONF-710301-(Vol.1), pp 44-50) INTEGRAL TESTING OF MODIFICATIONS TO ENDF/B VERSION II DATA. Paik, N. C.; Pitterle, T. A.; Durston, C. (Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Reactors Div.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The results of integral testing against critical experiments of ENDF/B Version II data and of modifications to this data are described. Modifications of the data were tested against experiment individually and collectively to obtain a modified data set which yields improved agreement with integral experiments of interest to LMFBR design analyses. Eleven critical assemblies were analyzed including assemblies covering a wide range of neutron spectra, fissile/fertile ratios, and core size with both uranium blankets and nickel reflectors. Assemblies of particular interest to LMFBR design include ZPPR-2, ZPR-3-56B, ZPR-3-48, ZPR-6-6A and ZPR-6-7. Eigenvalues were calculated to better than 1% accuracy for nine of eleven assemblies with only Zebra 2 and 3 having eigenvalues 1.3% low. Central reaction rate ratio calculations with Adjusted ENDF/B Version II data are shown to be in good agreement with measured ratios. This adjusted data improves the central material worths in ZPR-3-48. (auth)

1643 (CONF-710301-(Vol.1), pp 51-7) CALCULATIONS FOR FAST REACTOR BENCHMARKS WITH VERSION-II ENDF/B DATA. Pennington, E. M. (Argonne National Lab., Ill.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Calculations were performed for six fast reactor benchmark assemblies with a wide range of spectra using Version-II ENDF/B neutron cross section data. Multigroup cross sections for each assembly were produced using the Argonne MC^2 code, and were used in S_n transport- or diffusion-theory calculations to obtain reactor parameters. These include k_{eff}, activation ratios, central reactivity worths, effective delayed neutron fractions and prompt neutron lifetimes. Comparisons are made with experimental data wherever possible. The values of k_{eff} are too low, especially for the Pu-239 fueled assemblies. Revisions in the data suggested by an ENDF/B task force led to k_{eff} values in better agreement with experiment. (auth)

1644 (CONF-710301-(Vol.1), pp 58-64) INTEGRAL COMPARISONS FOR FAST CRITICAL ASSEMBLIES. Hunter, R. E. (Valdosta State Coll., Ga.); Cremer, C. C.; Worlton, D. R. (Los Alamos Scientific Lab., N. Mex.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Comparisons are made between experimental and calculated integral parameters for plutonium and uranium fast neutron assemblies, and implications of these comparisons on the "best-fit" to microscopic data are discussed for a number of cases, including $\sigma_{n,\gamma}$ for ^{238}U and the fission spectrum for ^{235}U. Integral parameters used in these comparisons include bare and reflected assembly critical masses, spectral indices, and central core-replacement reactivity contributions. 17 references. (auth)

1645 (CONF-710301-(Vol. 1), pp 65-71) SENSITIVITY STUDIES OF THE EFFECT OF UNCERTAINTY IN THE $^{238}U(n,\gamma)$ AND IN THE $^{239}Pu(n,f)$ AND (n,γ) CROSS SECTIONS. Hummel, H. H. (Argonne National Lab., Ill.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The effects of current uncertainties in the cross sections below 1 MeV, believed to be the most serious for fast reactors, were studied for a spherical model of a large LMFBR. Total variations found for a probably pessimistic assumption for ^{238}U $\sigma(n,\gamma)$ uncertainty were about 3% in k, 0.10 in breeding ratio, 5% in sodium-void effect (out of a total effect of +2.7% k), and 20% in ^{238}U Doppler effect. For ^{239}Pu $\sigma(n,f)$ and $\sigma(n,\gamma)$ below 30 keV, disagreements among measurements (which are usually within error bars) correspond to a variation of about 1% in k, 0.05 in breeding ratio, 15% in sodium-void effect, and 12% in ^{238}U Doppler effect. Uncertainty in the ^{239}Pu fission cross section above 30 keV corresponds to a variation of several percent in k, about a ±5% uncertainty in the sodium-void effect, and minor changes in the other quantities. The most serious of these uncertainties are those in k and in breeding ratio. Improvement in knowledge of low energy ^{239}Pu cross sections has significantly reduced the uncertainty in reactivity coefficients. 27 references. (auth)

1646 (CONF-710301-(Vol.1), pp 72-8) ADJUSTMENTS TO ENDF/B, VERSION II DATA WHICH IMPROVE THE AGREEMENT BETWEEN CALCULATED AND MEASURED PARAMETERS FOR FAST BENCHMARK CRITICAL ASSEMBLIES. Cowan, C. L.; Hutchins, B. A.; Turner, J. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Eigenvalues, reaction rate ratios and reactivity worths which are calculated with the ENDF/B, Version II data tend to be in poor agreement with the measured values for a number of fast critical assemblies. For this reason it is necessary to adjust the Version II data for use in the Demonstration Plant and LMFBR design effort. Modifications to the coarse group cross sections which improve the agreement between calculated and measured integral

parameters for the critical assemblies are described. The principal modification is a 5-10% increase in the ^{239}Pu-fission cross section between 10 and 600 keV. Other adjustments include higher fission cross sections for ^{235}U and higher fission, lower capture and lower inelastic cross sections for ^{238}U. (auth)

1647 (CONF-710301-(Vol.1), pp 86-90 EFFECT OF INCIDENT-NEUTRON-ENERGY DEPENDENT FISSION-NEUTRON SPECTRA ON FAST-REACTOR CALCULATIONS. Leonard, Bowen R. Jr.; Thomsen, Duane H. (Battelle-Northwest, Richland, Wash. [Pacific Northwest Lab.]).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The effect of a fission-neutron spectrum whose average energy $\overline{E}$ depends on the energy E_i of the neutron inducing fission was studied by Monte Carlo calculations of a Godiva assembly. Identical calculations were made using Maxwellian spectra with (I) $\overline{E}$ = 1.98 MeV and (II) $\overline{E} = 1.98 + 0.048\ E_i$ MeV. The eigenvalue calculated for II is only 1.7 ± 2.2 mk larger than for I. The volume-averaged differential neutron spectrum calculated for II, however, shows a distinct hardening. The shape of the calculated spectrum of II above 2 MeV corresponds to an $\overline{E}$ of about 2.12 MeV indicating that the effect of the energy-dependent spectrum may have a bearing on apparent discrepancies between differential and integral fission spectra measurements. The spectral distortion, observed changes in spectral indices, and correlated effects of delayed-neutrons suggest that this phenomenon deserves more detailed consideration in the analysis of fast assemblies. (auth)

1648 (CONF-710301-(Vol.1), pp 91-7) INTEGRAL TESTS AND EVALUATION OF CROSS-SECTION DATA FROM STUDIES OF FAST NEUTRON TRANSPORT IN BULK MEDIA. Malaviya, B. K.; Kaushal, N. N.; Becker, M.; Burns, E. T.; Ginsberg, A.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A comprehensive program devoted to the integral checks of differential microscopic cross section data pertinent to the LMFBR Program, based on the study of fast neutron transport in bulk media, is described. Time-of-flight-measured fast neutron angular flux spectra at different positions in a simple, clean, homogeneous assembly are analyzed using ENDF/B data, MC^2 and SN transport calculations. In addition, continuous slowing down theory was developed to complement precise calculations by indicating direct relationships between cross-section uncertainties and spectra and by permitting comparisons with other data files. The result is a well-defined integral experiment with clear-cut interpretation. Most progress was made for iron. On the basis of cross-section uncertainties in iron and of their influence on spectra, preferred data and a redirection in emphasis in differential measurements and evaluation were recommended. 12 references. (auth)

1649 (CONF-710301-(Vol.1), pp 147-53) UNCERTAINTIES IN PREDICTING THERMAL NEUTRON SPECTRA AND LATTICE MULTIPLICATIONS FOR Al-5 WT PERCENT Pu FUELED LIGHT WATER SYSTEMS. Neill, J. M. (Gulf General Atomic, Inc., San Diego, Calif.); Prezbindowski, D. L. (Battelle-Northwest, Richland, Wash. [Pacific Northwest Lab.]).

From third conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

A parameter of prime importance in predicting the performance of plutonium fueled light water reactors is the thermal reaction rate. The accuracy of its prediction is directly related to the uncertainties in the calculational methods and cross-section data utilized. Areas of uncertainty are the determination of the thermal neutron space, energy, and angular distribution, and the effects of the cut off energy, energy group structure, integral versus differential transport theory, and weighting functions. Areas of uncertainty in the cross sections include the scattering cross section for H bound H_2O, and the uncertainty in capture and fission cross section for constituent materials principally plutonium. Comparisons of measured and calculated values of k_{eff} in lattice cells were made to evaluate the effects of these uncertainties. 24 references. (auth)

1650 (FRNC-TH-84) COMPARISON BETWEEN THE COREGRAF AND WIMS CODES FOR LATTICE COMPUTING. Reuss, Paul (Paris Univ., Orsay (France). Faculte des Sciences). [nd]. 152p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The results obtained with the COREGRAF and WIMS codes for lattice computing are compared. The methods of calculation are different and the direct results are not comparable; a series of measurable quantities had to be developed. A preliminary analysis of the methods themselves had to be done. Four calculations of U–graphite lattices with a cylindrical geometry, effected with WIMS code on the straight cross section, were available. The results are compared with those obtained with COREGRAF for the various reaction rates. The various absorption rates corresponding to the ten thermal groups of WIMS, and the migration areas obtained in the thermal and fast range are also compared. Although very different, both methods give the same results. In fact, the discrepancies between the terms of the comparison are always small and are explained by differences between the basic nuclear data used. In the fast range, WIMS calculations are more precise than those of COREGRAF, in the thermal range it is the reverse. (France)

1651 (INR-1205) NONLINEAR STABILITY ANALYSIS OF A HETEROGENEOUS REACTOR WITH TWO TEMPERATURE COEFFICIENTS. Kielkiewicz, M. (Institute of Nuclear Research, Warsaw (Poland)). Sep 1970. 15p. INIS.

A simple model of a heterogeneous reactor with one group of delayed neutrons and two temperature coefficients of reactivity is considered. The region of asymptotic stability in a parameter plane is investigated by means of Gyftopoulos' criterion and Krasovskii's method. (auth) (INIS)

1652 (N-71-30209) NONLINEAR OSCILLATIONS AND STABILITY BOUNDS IN A NUCLEAR REACTOR WITH LINEAR REACTIVITY FEEDBACK. Semiannual Report. Yee, Samuel (Arizona Univ., Tucson. Engineering Experiment Station). Jan 1971. 138p. (NASA-CR-119190). NTIS.

Systems of autonomous nonlinear differential equations describing the stability of a nuclear reactor with two reactivity feedbacks were analyzed to determine stability bounds. The system parameters used are representative of a fast reactor with in-core thermionic converters. Bounded regions are determined for the effective lifetime model and coupled temperature equations by means of computer surveys of exact solutions. The nature of the bounded trajectories indicates the existence of limiting planes in state space. A mathematical description of these planes yields results in close agreement with numerical calculations. All trajectories outside the bounded regions exhibit finite escape time. Stable domains in state space cannot be determined by observing the effects of power perturbations alone. All three variables, power, and the two temperatures, must be varied. Concentric limit cycles have not been found for the effective lifetime model. (auth) (STAR)

1653 (UJV-2454-RF) REACTIVITY COEFFICIENTS IN FAST REACTORS. Osmera, B. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1970. 34p. (In Czech). INIS.

Application of the perturbation theory to calculation of reactor parameters is reviewed. Special attention is paid to the thermal coefficients of reactivity in fast reactors. Calculated sodium and temperature coefficients of the ZRR experimental fast reactor are given. Also described is the application of the perturbation theory in the analysis of some experiments on critical assemblies, e.g., the measurement of central reactivity coefficients, and experiments with reduced reactor core. (INIS)

1654 (UJV-2547-R-F) USE OF GALERKIN'S METHOD FOR SOLVING MULTIGROUP DIFFUSION EQUATIONS. Gmitrova, E. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 8p. (In Czech). INIS.

The method is briefly described of solving a set of one-dimensional multigroup diffusion equations, and its application in the calculation of k_{eff} and the neutron flux in a finite cylindrical reactor is reported. The input data are also briefly given of program ONE, written for this method in FORTRAN IV. (INIS)

1655 NEW METHOD FOR MEASUREMENT OF THE EFFECTIVE FRACTION OF DELAYED NEUTRONS FROM FISSION. Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, Tenn.). Nucl. Sci. Eng.; 46: No. 1, 147-8(Oct 1971).

The effective delayed neutron fraction can be obtained from the ratio of the time-correlated counts in a randomly pulsed neutron measurement to those in a Rossi-α measurement. In the randomly pulsed neutron measurement a ^{252}Cf source is placed in the reactor, which also contains a detector that does not count particles from the source. A time analyzer is triggered each time a ^{252}Cf nucleus fissions and measures the time distribution of neutrons from the fission chains initiated from ^{252}Cf fission at time t = 0. An expression for the above-mentioned ratio is found which is independent of the prompt-neutron lifetime and, for a given reactor, depends only on the prompt-neutron multiplication factor, the location of the ^{252}Cf source, and the efficiency of the detector. For a delayed critical system this ratio depends on the increment of the multiplication factor between delayed and prompt criticality. Preliminary measurements based on these ideas were made. (R.W.R.)

1656 THERMAL NEUTRON DECAY IN A SPHERICAL MODERATOR WITH A CENTRAL CAVITY. Grosshoeg, G.; Roennberg, G. (Chalmers Univ. of Tech., Goteborg). J. Nucl. Energy; 25: No. 8, 361-71(Aug 1971).

The decay of a neutron burst in a spherical moderator containing a central cavity was investigated. Experiments were performed on water moderators with the outer radii 4.6 and 10.0 cm. The inner radii were 0 to 4.1 and 0 to 8.2 cm respectively. Comparisons were made with a dynamic P_1-model and with Monte-Carlo calculations. It was found that the decay is not strictly exponential. However, the distributions are well-behaved, and the pseudomodes are well accounted for by the dynamic P_1-model in all the cases but the thinnest moderator shells. (auth)

1657 MODAL NODAL TRANSPORT ANALYSIS. Johnson, R. Douglas (Korea Inst. of Science and Tech., Seoul. Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 3: No. 3, 121-8(Sep 1971).

A unified modal-nodal expansion of the angular distribution of neutron flux in one spatial dimension is considered. Several standard nodal and/or modal methods of analysis are shown to be specializations of this technique. The modal-nodal moment form of the mono-energetic transport equation with isotropic sources and scattering is derived and the infinite medium eigenvalue problem solved. The technique is shown to yield results which approximate the exact value of the inverse diffusion length in non-multiplying media more accurately than standard methods of equal or somewhat greater computational complexity. (9 references) (auth)

1658 NEUTRON SPECTRA IN HETEROGENEOUS SYSTEMS. Takeda, Toshikazu (Osaka Univ., Suita, Japan). Nippon Genshiryoku Gakkai Rochuseishi Kenkyu Senmon Iinkai Hokoku; No. 30, 1-18(Sep 1970). (In Japanese).

A method using collision probability was investigated to obtain neutron distribution in systems having high heterogeneity such as advanced thermal reactors. Collision probability with which neutrons generated uniformly in one divided region of the system collides in other region was calculated. Average flux in each retion can be obtained with the collision probability. An approximate equation of the collision probability in a cluster system was introduced. Calculation of this equation was performed with consideration of the probability in a cylindrical cell and Dancoff coefficients. Collision probabilities of cluster systems including seven or twenty-eight fuel rods were compared with accurate values, and good agreement was obtained. Anisotropy of neutron distribution was taken into account when light elements were used for coolant or moderator. Effects of finite times of scattering in one region and direction of neutron path were taken into consideration in the calculation which satisfies the reciprocity theorem and conservation law. (Japan)

1659 SOLUTION OF ONE VELOCITY KINETIC EQUATIONS FOR NEUTRON TRANSPORT IN A SPHERICAL GEOMETRY WITH SCATTERING AS A LINEAR FUNCTION OF ANGLES. Shkurpelov, A. A.; Shikhov, S. B.; Ershov, Yu. I. Zh. Vychisl. Mat. i Mat. Fiz.; 10: No. 3, 767-73(May-Jun 1970). (In Russian).

A semivariant-rate nonhomogeneous equation for neutron transport with nonuniform boundary conditions in a homogeneous sphere with linear scattering was expanded for the case of anisotropic scattering. The analytical formulas obtained were used for calculating the critical dimensions of a spherical reactor considering the scattering anisotropy and the neutron flux in the spheres of external and internal sources. (R.V.J.)

Dynamics

1660 (BARC/I-74) SOME PHYSICS ASPECTS OF REACTOR CONTROL. Purandare, H. D. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 11p. INIS.

Some physics problems of reactor dynamics and control are described emphasizing the mathematical methods and techniques employed. These include an optimum fuel management scheme, problems with xenon, response to reactivity changes and the stability of a reactor with feedback effects. It is stated that the thermal and hydraulic behavior of the reactor can be linked with the neutronic part through a grand array of coupled blocks and the solution can be obtained by computer simulation in the linear base. (INIS)

Experimental Applications

1661 MEASUREMENT OF THE NUCLEAR DOPPLER EFFECT WITH A TWO-REGION SAMPLE. Liebelt, Kenneth Harry. Madison, Wis.; Univ. of Wisconsin (1971). 102p. University Microfilms Order No. 71-16,877.

Thesis.

The use of a heated sample to measure the Doppler effect in a fast reactor introduces a heterogeneity in a system otherwise generally assumed to be homogeneous. This is referred to as sample-core interaction since the sample environment affects the temperature-induced change in reactivity. In previous measurements, other effects with large uncertainties were present such that it was not possible to determine whether this heterogeneity was being properly taken into account. These uncertainties included the presence of unresolved and overlapping resonances as well as those due to unknowns in cross section data. An experiment was performed to investigate sample-core interaction in the absence of the above uncertainties. Gold (^{197}Au) was used as the resonance absorber as it exhibits one large, well-defined resonance in the low eV range. The measurements were performed in the University of Wisconsin Nuclear Reactor. Sample-core interaction was simulated by use of a two-region sample in the form of cylindrical annuli. Each sample region contained a homogeneous mixture of absorber and diluent (Al_2O_3) powders. The sample was 5 cm. in diameter and 27 cm. in length. It was located in a voided, cadmium-lined facility at the core center. The Doppler effect of the inner region of the sample was determined for various outer-region absorber concentrations. A temperature oscillation technique was employed using resistance heating and gas cooling between 395°K and 648°K; the outer region was maintained at 395°K. The temperature-induced reactivity changes were determined by, first, recording the time-dependent neutron flux level on a multichannel analyzer operating in the multiscaling mode. Inverse kinetics equations were then used to determine the reactivity. Background measurements were performed so that the Doppler effect could be isolated from the other temperature effects. The measured values were compared with those predicted by commonly used analytical techniques. One-dimensional integral transport theory was used to calculate effective group cross sections for the resonanance at the upper and lower temperature limits. These were used in a one-dimensional group-diffusion-theory criticality calculation to yield the Doppler effect by first-order perturbation techniques. Comparison of measured and predicted results revealed a discrepancy in the dependence of the Doppler effect with outer-region absorber density; the measured values were less than those predicted at intermediate outer-region concentrations. The simplicity of the experiment suggests that the discrepancy results from inadequacies in the calculational techniques. Specifically, the lack of fine-group adjoint weighting may be significant. (Diss. Abstr. Int., B)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 25, 141, 238, 240, 241, 245–247, 249, 254, 294, 371, 376, 414–416, 489, 490, 568, 592, 593, 613, 615, 642, and 644.

1662 (INIS-mf-107) INDUSTRIAL ASPECTS OF THE NUCLEAR FUEL CYCLE IN EUROPE. Gimstedt, O.; Maartensson, M.; von Bonsdorff, M.; Halle, L.; Terjesen, S. G.; Marcus, F. (Swedish Nuclear Industry Group, Stockholm). 21 Sep 1970. 63p. (CONF-700903-24). INIS.

From fourth Foratom Congress on industrial aspects of the nuclear fuel cycle in Europe; Stockholm, Sweden (21 Sep 1970).

Resumés of papers presented at the six sessions of the congress cover the following topics: the uranium market, uranium demand, uranium resources and production capacities, exploration, uranium enrichment, gaseous diffusion, gas centrifuges, nozzle separation, plutonium production and supply, plutonium recycling, fuel manufacturing, reprocessing, waste processing, handling and transport of irradiated fuel, and cask design. (INIS)

1663 (IRS-I-45) METHODS FOR ROUGH MEASUREMENT OF LEAKAGE RATE OF REACTOR CONTAINMENT VESSELS. Engel, M. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). 1970. 21p. (In German). INIS.

Thermodynamical and gas analytical methods in stationary and instationary state are compared for their applicability for a rough measuring procedure of leakage rates of containment vessels with external and internal ventilation. The exceeding of a leakage rate limit within a measuring time of some days could be detected reliably with a pressure drop procedure (discontinuous) by use of a comparison system. (INIS)

1664 (IRS-T-19, pp 16-20) CONSIDERATIONS TO RESEARCH STUDIES CONCERNING CRACK PROPAGATION IN REACTOR PRESSURE VESSELS. Weidemann, W. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). 1970. (In German). INIS.

Fracture mechanical investigations are planned on thick samples for clearing up the following questions: (1) Under what conditions is a slow subcritical crack propagation to be expected. (2) How does the fracture behavior of thick-walled vessels change during operation? (INIS)

1665 (KFK-1205) DRAG COEFFICIENTS FOR FUEL ELEMENT SPACER GRIDS. Rehme, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Apr 1970. 4p. (In German). INIS.

The results of pressure drop measurements with five different spacer grids in rod bundles are reported. The rod bundles consisted of 37 (169) rods arranged in a hexagonal array and contained in a prismatic hexagonal channel. The experimental results are correlated by introducing a modified drag coefficient. For preliminary core design calculations it is possible by means of this coefficient and of the flow restriction due to the spacer to predict the pressure loss across various spacer grids with good approximation. (auth) (INIS)

1666 (N-71-26938) MODIFICATIONS OF THE CYGRO-2 COMPUTER PROGRAM. Fiero, Ivan B. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1971. 51p. (NASA-TM-X-2150). NTIS.

Modifications made to the CYGRO-2 computer program are presented. The CYGRO-2 program is a Westinghouse-Bettis-developed program for the mechanical analysis of irradiated, cylindrical geometry, nuclear reactor fuel pins subjected to fuel swelling due to the fission products. The modified program is compatible with the IBM 7094 computer. Results of the modifications are shorter computer times and improved convergence. A sample problem for a uranium mononitride fuel pin is included, with detailed discussion of input data and the difficulties encountered. Computer problems encountered in using the program are detailed both in the discussion of the modification and in the discussion of the sample problem. (auth) (STAR)

1667 (UJV-2492-RA) MEASUREMENT OF FUEL ELEMENT DILATATION IN A LOOP EXPERIMENT WITH A FINNED TUBULAR ELEMENT MODEL. Krylova, H. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Jul 1970. 11p. (In Czech) INIS.

The performance of two types of induction sensors of dilatometers used to determine changes in fuel element length was tested in a loop experiment with a finned fuel element. Their sensitivity and dependence on temperature and on structure dilatations were examined. The effects were studied which distort the dilatometer readings and their causes were analyzed. Suggestions for improving the reliability of measurement are given. (INIS)

1668 APPARATUS FOR THE STUDY OF THERMAL CYCLING OF ELEMENTS PARTICULARLY NUCLEAR REACTOR FUEL ELEMENTS. Dubouch, Claude; Petit, Maurice (to Commissariat a l'Energie Atomique). U. S. Patent 3,599,475. 17 Aug 1971. Priority date 5 Jan 1968, France.

The apparatus known as a "cycler" is made up of a gastight container in which a gas pressure can be maintained, a specimen-carrier fitted with thermocouples, a furnace surrounding said specimen-carrier, and an internal heat-insulation system placed between the specimen-carrier and the internal wall of the container. The heat-insulation system is essentially made up of a stationary portion and a portion which is capable of moving with respect to this latter. The stationary portion is constructed with metallic sheets provided with aligned windows and maintained in spaced relation. The movable portion is constructed with metallic sheets provided with windows which are identical with those of the stationary portion. And the sheets of the movable portion are interposed between the sheets of the stationary portion. (auth)

1669 STRUCTURAL BEHAVIOR OF PRESTRESSED CONCRETE REACTOR VESSELS. Paul, Stanley L. (Univ. of Illinois, Urbana). J. Struct. Div., Amer. Soc. Civil Eng.; 97: No. ST 7, 1879-96(Jul 1971).

A series of 16 tests of small-scale prestressed concrete pressure vessels is described, and approximate techniques are developed to predict their capacity. The most common configuration for vessels of this type was chosen for modeling. This shape is basically cylindrical with deep end slabs anchored to the walls with longitudinal prestressing tendons. The specimens were proportioned to represent one end slab and a portion of the adjacent wall. Tests results are presented. 6 references. (auth)

1670 NUCLEAR REACTOR ASSEMBLY. Martin, Georges (to Societe des Forges et Ateliers du Creusot). French Patent 2,043,461. 19 Feb 1971. Filed 6 May 1969. (In French).

The invention is related to a nuclear reactor assembly. It comprises a system for holding the upper part of the columns in position, enabling their free expansion, and for stopping the neutrons and γ radiations leaking out of the core. This device also enables the columns to be moved one by one. Each column is supplied with an end part which plugs the gap between the columns. The plugging element comprises a base, several holders fixed to this base and several movable plugging parts inserted between the fixed holders and having a thickness greater than that of the gap between the columns. The fixed holders and the plugging parts form together a prismatic surface with a section approximately equal to that of the corresponding column. Each plugging system is combined with a drawback-system. (France)

1671 NUCLEAR FUEL SIMULATION BY ELECTRIC HEATERS. Teytu, A. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 156, 13-22(Feb 1971). (In French).

Electric heaters simulate nuclear fuel elements for heat transfer experiments. The various technics involved in the development of these simulators are described. Technical solutions used for special heaters are presented. Plate type and bundle type simulators, heaters with either a directly heated jacket or with a sheath electrically insulated from the supply unit are examined. The criteria for selecting a simulator are functions of the experimental conditions, the feasibility, the operation and safety of the loop. (France)

1672 MATERIAL WORTH MEASUREMENTS WITH A FUEL-FILLED PILE OSCILLATOR ROD. Kussmaul, G.; Meister, H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Energy; 25: No. 8, 373-89(Aug 1971).

A method to determine the reactivity worth of material samples within an undisturbed environment by a pile oscillator is described. In contrast to the usually performed pile oscillator measurements the oscillator rod consisted of a tube filled with the material of the environmental core in which the sample was embedded. By this method, perturbations of the real and adjoint spectra, and of the angular neutron distribution were considerably reduced. A simple, theoretical model that describes the kinetic behavior of the reactor during the oscillation is presented. The method and the theoretical model were investigated on the fast-thermal Argonaut reactor STARK. Results show the benefits of the proposed procedure and the applicability of the model. (auth)

1673 EFFECTS INDUCED BY NEUTRON IRRADIATION IN STRUCTURAL MATERIALS OF REACTORS. Jimenez, Jose Lopez. Energ. Nucl. (Madrid); 15: No. 71, 197-208(May-Jun 1971). (In Spanish).

Reactor structural materials are exposed to high neutron doses with a consequent disordering of the crystalline lattice. This disordering results in significant changes in the physical properties. The changes in the physical properties are particularly sensitive to the fast neutron flux, the neutron spectrum, the neutron dose, and the irradiation temperature. A mathematical formalism was established which connects these four parameters to the total number of defects created in the material. The formalism was established from theoretical models of defect formation and makes possible the evaluation of defects both in different reactors and at different points in the same reactor. By means of theoretical-experimental correlations, the function which connects the total number of defects to the variations of the physical properties of structural materials can be determined. The correlations can be used to predict, to some extent, the evolution of the material with time. Various experimental confirmations of the formalism were presented. The creation of helium atoms by transmutation in austenitic steels of fuel element claddings was interpreted as a qualitative representation of the deterioration at other temperatures. (25 references) (tr-auth)

1674 END PIECES FOR PLUGGING THE GAPS BETWEEN THE PRISMATIC COLUMNS OF A NUCLEAR REACTOR. Lemoing, Pierre; Radiguet, Pierre (to Societe pour l'Industrie Atomique (SOCIA)). French Patent 2,041,749. 5 Feb 1971. Filed 20 May 1969. (In French).

The invention concerns end pieces for plugging the gaps between the prismatic elements of the polygonal columns constituting the core of a high temperature reactor. These end pieces plug the upper part of the gaps between the faces of adjacent columns. They are intended as a protection against the radiation emitted from the nuclear fuel incorporated in the column material. Facilities for their removal, either simultaneously with the column or before the column, must exist. In the first case they accompany the column as it is lifted into the tube or sheath of the loading machine. Each end piece processes a top part which extends transversely according to

the width of the opposite column faces and a body which assures the effective plugging. The lower part of these end pieces is shaped like a staple and is seated upon supporting bars attached to the opposite faces of the adjacent columns. (France)

1675 GAS LOOP ARRANGEMENT IN A HIGH TEMPERATURE NUCLEAR REACTOR. Bitsch, Daniel; Laurent, Noeel (to Societe pour l'Industrie Atomique (SOCIA)). French Patent 2,041,724. 5 Feb 1971. Filed 13 May 1969. (In French).

The invention is related to the arrangement of the gas loops in a high temperature gas cooled reactor. A prestressed concrete vessel contains the core of the reactor; the numerous shafts, which house the exchangers and the blowers of the coolant loop are enclosed within the side wall of this vessel. Each shaft contains a heat exchanger. The lower part of each exchanger is extended by the inlets and outlets of the secondary exchange fluid and separated from the wall of the shaft by an annular duct which circulates the outgoing coolant fluid. A first tube traverses the vessel wall and connects the exchanger input to a hot fluid collector leaving the core. A second tube traverses the vessel wall and connects the annular duct to a point inside the vessel near the output of the first tube. A blower which ensures the circulation of the coolant is fixed to the upper part of the shaft. (France)

1676 DEVICE FOR DIRECTING AND HANDLING THE PRISMATIC ELEMENTS OF A NUCLEAR REACTOR CORE. Lemoing, Pierre (to Societe pour l'Industrie Atomique SA). French Patent 2,045,644. 5 Mar 1971. Filed 13 Jun 1969. (In French).

A device for handling and directing the prismatic channels assembled to form the lattice of a nuclear reactor core is presented. It is inserted inside a cylindrical guiding tube with a vertical axis carried by the conveyor of a handling machine moving above the core. It consists of an assembly of jointed shutters operated by synchronized actuators. (France)

1677 DEVICE FOR MEASURING THE TEMPERATURES INSIDE A NUCLEAR REACTOR. Margueron, Jean (to Societe pour l'Industrie Atomique). French Patent 2,050,295. 2 Apr 1971. Filed 18 Jul 1969. (In French).

A device for measuring temperatures inside a nuclear reactor, especially inside a high temperature reactor is presented. The type of core considered consists of prismatic elements, piled up in adjacent vertical columns and containing a homogeneous mixture of nuclear fuel and graphite as a supporting material. The device consists of a metallic structure, in two parts, supported by the reactor columns. This structure consists of a grid made of a cell lattice similar to the lattice of the columns, including a central and peripheral independent part and supporting at least a thermocouple in each cell of the lattice. (France)

GENERAL

1678 (ACRH–1000–272) STRUCTURE OF HUMAN SERUM LIPOPROTEINS. Scanu, Angelo M. (Chicago Univ., Ill. Pritzker School of Medicine. Argonne Cancer Research Hospital, Chicago, Ill.). 2 Jun 1971. Contract AT(11-1)-69. 32p. (CONF-710632-1). Dep. NTIS.
From Conference on membrane structure and its biological applications; New York, N. Y. (2 Jun 1971).

1679 (AEC-tr-7277) CONTRIBUTION TO THE STUDY OF THE BIOLOGICAL EFFECTS OF MERCURY AND SILVER IN SEA WATER. Soyer, J. Translated by W. J. Grimes from Vie Milieu; 14: No. 1, 1-6(1963). 38p. Dep. NTIS.

1680 (AEC-tr-7283) CHELONS. 40. THE PROTONATION CONSTANTS OF SEVERAL CHELONS IN DIFFERENT AQUEOUS SALT MEDIA ($NaClO_4$, $(CH_3)_4NCl$, KNO_3). Anderegg, G. Translated by Elizabeth W. Baumann (Savannah River Lab., Aiken, S. C.), from Helv. Chim. Acta; 50: No. 8, 2333-40(1967). 12p. Dep. NTIS.

1681 (ANCR–1024) EVALUATION OF FAILURE AND FAILURE RELATED DATA. Vesely, W. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Aug 1971. Contract AT(10-1)-1375. 37p. Dep. NTIS.

1682 (ANL–7803) GPTHEORY: A FORTRAN COMPUTER PROGRAM FOR DETERMINING MOLECULAR SYMMETRY PROPERTIES. Bouman, Thomas D.; Goodman, Gordon L. (Argonne National Lab., Ill.). Apr 1971. Contract W-31-109-eng-38. 108p. Dep. NTIS.

1683 (ANL–7855) NUMERICAL SOLUTION OF THE ORR–SOMMERFELD EQUATION AT LARGE REYNOLDS NUMBER. Hughes, Thomas H. (Argonne National Lab., Ill.). Sep 1971. Contract W-31-109-eng-38. 36p. Dep. NTIS.

1684 (ANL/ES–6) WIND-DRIVEN CURRENTS IN A LARGE LAKE OR SEA. Birchfield, G. E. (Argonne National Lab., Ill.). Jul 1971. Contract W-31-109-eng-38. 17p. Dep. NTIS.

1685 (CALT–767-P-6-X-6) STUDIES IN DEVELOPMENTAL IMMUNOGENETICS. Annual Progress Report. Owen, Ray D. (California Inst. of Tech., Pasadena. Div. of Biology). 30 Aug 1971. Contract AT(04-3)-767. 12p. Dep. NTIS.

1686 (CALT–822-36) ELECTRICAL AND MAGNETIC PROPERTIES OF AMORPHOUS Pd–Si ALLOYS CONTAINING Fe AND Cr. Hasegawa, Ryusuke (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Sep 1971. Contract AT(04-3)-822. 17p. Dep. NTIS.

1687 (CALT–822-38) FERROMAGNETIC RESONANCE IN AN AMORPHOUS Co–Pd–Si ALLOY. Hasegawa, Ryusuke (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Oct 1971. Contract AT(04-3)-822. 6p. Dep. NTIS.

1688 (CONF-710924-1) GOLGI APPARATUS AND GEOTROPISM. Shen-Miller, J. (Argonne National Lab., Ill.). 1971. 20p. Dep. NTIS.
From Conference of modern aspects of hormonal regulation in plant growth and development; Izmir, Turkey (20 Sep 1971).

1689 (CONF-711023-1) APPROACH TO ATTAINING RESPONSIBLE ENGINEERING ACTION. Bender, M. (Oak Ridge National Lab., Tenn.). [nd]. 11p. Dep. NTIS.
From twenty-fifth annual quality control conference; Hartford, Conn. (14 Oct 1971).

1690 (COO–1198–853) EFFECTS OF UNIAXIAL COMPRESSION ON THE THIRD ZONE FERMI SURFACE OF ALUMINUM. Spurgeon, William Alexander (Illinois Univ., Urbana). Oct 1971. Contract AT(11-1)-1198. 94p. Dep. NTIS.

1691 (COO–1332–26) A CONTRIBUTION TO A BIBLIOGRAPHY OF THE RACCOON (PROCYON LOTOR). Sanderson, Glen C. (Illinois Natural History Survey, Urbana); Mech, L. David; Schnell, Jay H. (Minnesota Univ., Minneapolis. Museum of Natural History). Sep 1971. Contract AT(11-1)-1332. 82p. Dep. NTIS.

1692 (COO–1431-12) EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED FCC METALS AND ALLOYS. Technical Progress Report No. 7, September 1, 1970–September 1, 1971. Mikkola, D. E. (Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering). Contract AT(11-1)-1431. 31p. Dep. NTIS.

1693 (COO–1469-191) GRAPHICS 8: SYSTEM MAINTENANCE (HARDWARE). Nickolls, J.; Michel, M. J. (Illinois Univ., Urbana. Dept. of Computer Science). Aug 1971. Contract AT(11-1)-1469. 45p. Dep. NTIS.

1694 (COO–1599-41) INTERACTIONS OF DISSOLVED AND PARTICULATE NITROGEN IN LAKE METABOLISM. Manny, Bruce Andrew (Michigan State Univ., East Lansing). 1971. Contract AT(11-1)-1599. 202p. Dep. NTIS.
Thesis.

1695 (COO–1599-43) PRODUCTION OF DISSOLVED ORGANIC MATTER FROM DEAD GREEN ALGAL CELLS. II. ANAEROBIC MICROBIAL DECOMPOSITION. Otsuki, Akira; Hanya, Takahisa (Tokyo Metropolitan Univ., Tokyo. Dept. of Chemistry. Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station). [1971]. Contract AT(11-1)-1599. 27p. Dep. NTIS.

1696 (COO–2110-1) ELECTRON MICROSCOPE CONTAMINATION FORMATION AND CONTRAST. Final Report, September 1, 1970–August 31, 1971. Hines, R. L. (Northwestern Univ., Evanston, Ill.). 1 Sep 1971. Contract AT(11-1)-2110. 6p. Dep. NTIS.

1697 (COO–2118-18) SPEECH DISPLAY SIMULATION SYSTEM FOR A COMPARATIVE STUDY OF SOME VISUAL SPEECH DISPLAYS. Nordmann, Bernard J. Jr. (Illinois Univ., Urbana. Dept. of Computer Science). Aug 1971. Contract AT(11-1)-2118. 226p. Dep. NTIS.

1698 (COO–2118-22) ILLIAC III COMPUTER SYSTEM MANUAL: TAXICRINIC PROCESSOR. VOLUME 2. Report No. 475. Nordmann, Bernard J. Jr. (Illinois Univ., Urbana. Dept. of Computer Science). 24 Aug 1971. Contracts AT(11-1)-1018; AT(11-1)-2118. 316p. Dep. NTIS.

1699 (COO–2118-23) ILLIAC III COMPUTER SYSTEM MANUAL: TAXICRINIC PROCESSOR. VOLUME 3. Nordmann, Bernard J. Jr. (Illinois Univ., Urbana. Dept. of Computer Science). 24 Aug 1971. Contracts AT(11-1)-1018; AT(11-1)-2118. 284p. Dep. NTIS.

1700 (COO–2118-24) COMPARATIVE STUDY OF SOME VISUAL SPEECH DISPLAYS. Nordmann, Bernard J. Jr. (Illinois Univ., Urbana. Dept. of Computer Science). 10 Sep 1971. Contracts AT(11-1)-1018; AT(11-1)-2118. 115p. Dep. NTIS.
Thesis.

1701 (CTC–52) RECOST NETWORK DESIGN MODEL. Van Wie, Nelson H.; Cross, Kenneth E. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 1 Nov 1971. Contract W-7405-eng-26. 29p. Dep. NTIS.

1702 (CU–3712-19) DILATOMETRIC AND X-RAY THERMAL EXPANSION IN NON-CUBIC CRYSTALS. I. ROLE OF DISLOCATION CLIMB. Nowick, A. S. (Columbia Univ., New York. Henry Krumb School of Mines); Feder, R. (IBM Watson Research Center, Yorktown Heights, N. Y.). [1970]. 28p. Dep. NTIS.

1703 (HEDL-SA-289) BIOLOGICAL CONSIDERATIONS FOR THE DESIGN OF THERMAL POWER PLANT INTAKE STRUCTURES. Sonnichsen, J. C. Jr.; Bentley, Bruce W. (Hanford Engineering Development Lab., Richland, Wash.). [1971]. Contract AT(45-1)-2170. 18p. (CONF-711022-1). Dep. NTIS.
From second annual thermal power and eighth biennial hydraulics conference; Pullman, Wash. (5 Oct 1971).

1704 (HMI-B–112) ANNUAL REPORT, 1970. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Jul 1971. 210p. (In German).
During the year 1970, the sector of nuclear chemistry focussed its work mainly on the study of radionuclides and trace elements in geochemical and biochemical systems. Also studied were actinide chemistry, reactor chemistry, and both transport processes and radiation effects in solids. The section on radiation physics centered its work on the study of primary processes of radiation. Angular distribution and energy distribution were studied for delta electrons produced in gases by exposure to protons. The sector on environmental physics and environmental biophysics primarily studied the effects of aerosols on the human respiratory system. Studies of fallout contamination with respect to surface waters were continued. The health physics division performed routine monitoring without encountering any significant incidents. (H.B.G.)

1705 (HN–205) CONVENTIONAL EXCAVATION BY HYDRAULICKING METHODS FOR THE INTEROCEANIC CANAL. Perla, H. F.; Tierney, M. P. (Holmes and Narver, Inc., Los Angeles, Calif.). May 1969. 37p. Dep. NTIS.

1706 (INIS-mf-47) TWENTY-FOURTH ANNUAL REPORT OF THE ATOMIC ENERGY CONTROL BOARD OF CANADA, 1969–1970. (Atomic Energy Control Board, Ottawa (Ontario)). 1970. 46p. INIS.

1707 (IS-T-141) MAGNETISM AND BONDING IN POTASSIUM TRICHLOROCUPRATE(II). Maass, George Joseph (Ames Lab., Iowa). Nov 1969. Contract W-7405-eng-82. 118p. Dep. NTIS.
Thesis.

1708 (IS-T-382) ULTRAHIGH VACUUM STUDY OF WETTING IN LIQUID METAL–SOLID METAL SYSTEMS. Maze, Robert Craig (Ames Lab., Iowa). Oct 1971. Contract W-7405-eng-82. 99p. Dep. NTIS.
Thesis.

1709 (K-L-6280) K-II CENTRIFUGE FLOW IMPROVEMENT. Cho, N. (Oak Ridge Gaseous Diffusion Plant, Tenn.); Breillatt, J. P.; Brantley, J. N.; Anderson, N. G. (Oak Ridge National Lab., Tenn.). 26 Oct 1971. Contract W-7405-eng-26. 14p. Dep. NTIS.

1710 (LA-4635) SPHERICAL EXPLOSIONS IN WATER. Hantel, L. W.; Davis, W. C. (Los Alamos Scientific Lab., N. Mex.). Oct 1971. Contract W-7405-eng-36. 25p. Dep. NTIS.

1711 (LBL-37) STUDY OF THE EFFECTS OF ULTRASONIC WAVES ON THE REPRODUCTIVE INTEGRITY OF MAMMALIAN CELLS CULTURED IN VITRO. Martins, Bambino Isidonio (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1971. Contract W-7405-eng-48. 112p. Dep. NTIS.
Thesis.

1712 (LBL-112) PHASE-MATCHED THIRD-HARMONIC GENERATION IN CHOLESTERIC LIQUID CRYSTALS. Shelton, John W. (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1971. Contract W-7405-eng-48. 109p. Dep. NTIS.

1713 (LBL-113) THEORETICAL AND EXPERIMENTAL STUDIES OF FLOW AND FRACTURE IN MONOCRYSTALLINE SILICON. St. John, Charles Falding (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1971. Contract W-7405-eng-48. 87p. Dep. NTIS.
Thesis.

1714 (LBL-114) THERMAL ION-MOLECULE REACTIONS IN GASEOUS METHANE–OXYGEN MIXTURES. Horton, Robert Louis (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1971. Contract W-7405-eng-48. 192p. Dep. NTIS.
Thesis.

1715 (NYO-1710-103) STUDIES ON ULTRA-CLEAN CARBON SURFACES. V. KINETICS OF CHEMISORPTION OF OXYGEN ON DIAMOND. Bansal, R. C.; Vastola, F. J.; Walker, P. L. Jr. (Pennsylvania State Univ., University Park. Dept. of Materials Science). [1970]. 15p. Dep. NTIS.

1716 (NYO-2150-77) EVIDENCE FOR ELECTRON-PHONON UMKLAPP SCATTERING IN THE MAGNETORESISTANCE OF POTASSIUM. Taub, H.; Wagner, D. K. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Aug 1971. Contract AT(30-1)-2150. 13p. Dep. NTIS.

1717 (NYO-2802-76) MECHANISM OF BIOLUMINESCENCE, CHEMILUMINESCENCE, AND ENERGY TRANSFER. Progress Report, November 1970–August 1971. Seliger, H. H. (Johns Hopkins Univ., Baltimore, Md. McCollum-Pratt Inst.). Contract AT(30-1)-2802. 16p. Dep. NTIS.

1718 (NYO-2807-93) EFFECTS OF INTERFACIAL TENSION GRADIENTS ON THE MOTION OF DROPS AND BUBBLES. Saville, D. A. (Princeton Univ., N. J. Dept. of Chemical Engineering). [1971]. 33p. Dep. NTIS.

1719 (NYO-3504-61) ELECTRON MICROSCOPE STUDIES OF GRAIN BOUNDARY DISLOCATION BEHAVIOR. Report No. 1606. Balluffi, R. W.; Komem, Y.; Schober, T. (Cornell Univ., Ithaca, N. Y. Materials Science Center). Jul 1971. Contract AT(30-1)-3504. 51p. Dep. NTIS.

1720 (NYO-3699-61) NOTE ON THE BAND GAPS OF SEMICONDUCTOR ALLOYS. Stroud, David (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Jul 1971. Contract AT(30-1)-3699. 11p. Dep. NTIS.

1721 (NYO-3787-6) ROTATIONAL ORDERING IN THE SOLID MOLECULAR HYDROGENS. Progress Report, October 1, 1970–September 30, 1971. White, David (Pennsylvania Univ., Philadelphia. Dept. of Chemistry). Contract AT(30-1)-3783. 60p. Dep. NTIS.

1722 (NYO-3825-15) MACROMOLECULAR EVENTS CULMINATING IN THE INITIATION OF LENS PROTEIN SYNTHESIS. Final Report. Katoh, Arthur K. (Mercy Hospital, Pittsburgh, Pa. Cancer Research Lab.). 10 Aug 1971. Contract AT(30-1)-3825. 10p. Dep. NTIS.

1723 (NYO-4048-3) INFLUENCE OF IODINE INTAKE UPON KINETICS OF IODINE METABOLISM IN THE DOG. Progress Report, November 1, 1968–October 31, 1971. (Cornell Univ., New York. Medical Coll.). Contract AT(30-1)-4048. 56p. Dep. NTIS.

1724 (NYO-4095-7) VAPOR COMPRESSIBILITY EFFECTS IN HEAT PIPES. Final Report. Levy, Edward K. (Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering). 31 Aug 1970. Contract AT(30-1)-4095. 27p. Dep. NTIS.

1725 (NYO-4176-8) ELECTRICAL CONDUCTIVITY OF LIQUID BARIUM AND AN ESTIMATE OF ITS THERMAL CONDUCTIVITY. Genter, R. B.; Grosse, A. V. (Germantown Labs., Inc., Philadelphia, Pa.). Jun 1971. Contract AT(30-1)-4176. 17p. (GL-1971-3). Dep. NTIS.

1726 (NYO-4176-9) HIGH TEMPERATURE INORGANIC CHEMISTRY. Final Report. Grosse, A. V. (Germantown Labs., Inc., Philadelphia, Pa.). Jul 1971. Contracts AT(30-1)-2082; AT(30-1)-4176. 85p. (GL-1971-4). Dep. NTIS.

1727 (NYO-4209-14) MODELING GENERALIZED PARALLEL COMPUTER SYSTEMS. Regis, R. (Johns Hopkins Univ., Baltimore, Md.). May 1971. 22p. Dep. NTIS.

1728 (NYO-4209-15) MATHEMATICAL MODEL OF ASSIGNMENT FOR REALIZING MODULAR SEQUENTIAL LOGIC NETWORKS. Kartashev, Svetlana P. (Johns Hopkins Univ., Baltimore, Md.). Aug 1971. 50p. Dep. NTIS.

1729 (ORNL-HUD-24) DEMOGRAPHIC PROFILES OF THE UNITED STATES. VOLUME I. THE NATION, REGIONS, DIVISIONS, AND STATES. Lee, Everett S.; Levin, Martin L.; Pendleton, William W.; Postma, Patricia D. (Oak Ridge National Lab., Tenn.). Sep 1971. Contract W-7405-eng-26. 59p. Dep. NTIS.

1730 (ORNL-TM-3431) PHENOL POLLUTION OF WATER: A BIBLIOGRAPHY. Stemple, Ruth (comp.) (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 15p. Dep. NTIS.

1731 (ORNL-TM-3450) CHROMATE POLLUTION OF WATER–DETECTION, EFFECTS, AND PREVENTION: A BIBLIOGRAPHY. Stemple, Ruth (comp.) (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 20p. Dep. NTIS.

1732 (ORO-4152-1) CHELATION OF TRANSITION METALS BY DERIVATIVES OF 3-NITROSO-2-PYRIDINOL AND 5-NITROSO-4-PYRIMIDOL. Progress Report. McDonald, Curtis; Rhodes, Thornton (Southern Univ., Baton Rouge, La. Dept. of Chemistry). 10 Oct 1971. Contract AT(40-1)-4152. 13p. Dep. NTIS.

1733 (RFP-1717) LITERATURE SURVEY OF STRESS-CORROSION CRACKING AND HYDROGEN EMBRITTLEMENT IN HIGH STRENGTH STEELS. Briggs, John L. (Dow Chemical Co., Goldnen, Colo. Rocky Flats Div.). 17 Sep 1971. Contract AT(29-1)-1106. 12p. Dep. NTIS.

1734 (RFP-1733) CORROSIVE BEHAVIOR OF 304 AND 304L STAINLESS STEEL IN GASEOUS ENVIRONMENTS: AN ANNOTATED BIBLIOGRAPHY. Steward, Linden M.; Stakebake, Jerry L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 22 Oct 1971. Contract AT(29-1)-1106. 18p. Dep. NTIS.

1735 (RLO-2214-6) NATURAL CONVECTION HEAT TRANSFER BETWEEN A BODY AND ITS SPHERICAL ENCLOSURE. Weber, Norman (Montana State Univ., Bozeman). Dec 1971. Contract AT(45-1)-2214. 187p. Dep. NTIS.
Thesis.

1736 (RLO-2227-T-3-4) MUTANT STUDIES ON THE PHOTOSYSTEM II PORTION OF THE PHOTOSYNTHETIC PROCESS. Progress Report, September 1, 1970–September 1, 1971. Bishop, Norman I. (Oregon State Univ., Corvallis. Dept. of Botany). 24 Sep 1971. Contract AT(45-1)-2227. 25p. Dep. NTIS.

1737 (RLO-2227-TI-2) INFRARED SPECTRA AND GEOMETRIES OF RARE-EARTH DIHALIDES: SmF_2, $SmCl_2$, EuF_2, $EuCl_2$, YbF_2, AND $YbCl_2$. Dekock, C. W.; Wesley, R. D. (Oregon State Univ., Corvallis. Dept. of Chemistry); Radtke, D. D. (Wisconsin State Univ., Stevens Point. Dept. of Chemistry). [1971]. 15p. Dep. NTIS.

1738 (RLO-2229-T-1-5) TRACE METAL ASSOCIATIONS IN SUB-ARCTIC AND ARCTIC MARINE ENVIRONMENTS. Work

in Progress, June 1971. Burrell, D. C. (Alaska Univ., College. Inst. of Marine Science). Contract AT(45-1)-2229. 158p. (R-71-12). Dep. NTIS.

1739 (RPI-1044-25) ANISOTROPIC DIFFUSION AND ELECTROMIGRATION. Annual Report. Huntington, H. B. (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug 1971. Contract AT(30-1)-1044. 8p. Dep. NTIS.

1740 (RPI-3639-17) STUDIES OF GAS-PARTICLE HEAT TRANSFER COEFFICIENTS IN PACKED AND FLUIDIZED BEDS BY FREQUENCY RESPONSE TECHNIQUES. Final Report, January 1, 1966–September 1, 1971. Littman, Howard (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug 1971. Contract AT(30-1)-3639. 68p. Dep. NTIS.

1741 (SC-DC-70-5104-A) CORRELATION OF EXPERIMENTAL CARBON AND GRAPHITE ABLATION DATA FOR REENTRY VEHICLE NOSE TIP APPLICATION. Auerbach, I.; McVey, D. F.; McBride, D. D. (Sandia Labs., Albuquerque, N. Mex.). [1970]. 19p. (CONF-710116-1). Dep. NTIS.
From ninth aerospace sciences meeting; New York, N. Y. (25 Jan 1971).

1742 (SC-DC-705094) MICROSTRUCTURAL ANALYSIS OF FILAMENTARY COMPOSITES HAVING ORTHOTROPIC CONSTITUENTS. Biffle, J. H. (Sandia Labs., Albuquerque, N. Mex.) [1970]. 31p. Dep. NTIS.

1743 (SC-DC-714142) PHOTOGRAPHICALLY INCREASING THE EFFECTIVE RESOLUTION OF THE SD-4020. Robbins, Donald (Sandia Labs., Albuquerque, N. Mex.). [nd]. 9p. (CONF-711020-1). Dep. NTIS.
From tenth annual UAIDE meeting; Los Angeles, Calif. (25 Oct 1971).

1744 (SC-DC-714213) RECENT DEVELOPMENTS IN THE MEASUREMENT OF THERMAL DIFFUSIVITY. Acton, R. U. (Sandia Labs., Albuquerque, N. Mex.). [1971]. 8p. (CONF-711112-1). Dep. NTIS.
From Annual meeting of American Society of Mechanical Engineers; Washington, D. C. (28 Nov 1971).

1745 (SC-DC-714220) MANUFACTURING PROCESS FOR CERAMIC ENCAPSULATED JUNCTION FIELD EFFECT TRANSISTORS (JFETs) AND STATISTICAL EVALUATION OF JFET HEADER DIELECTRIC MATERIALS. Kern, H. E. (Bell [Telephone] Labs., Inc., Murray Hill, N. J.); McKenzie, J. M. (Sandia Labs., Albuquerque, N. Mex.); McQuaid, J. H. (California Univ., Livermore. Lawrence Radiation Lab.). [1971]. 11p. (CONF-711111-1). Dep. NTIS.
From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971).

1746 (SC-R-70-4389) ULTRASONIC EVALUATION OF CARBON–CARBON COMPOSITE MATERIALS. Baker, Robert A.; Irwin, John L. (Sandia Labs., Albuquerque, N. Mex.). Oct 1970. 31p. Dep. NTIS.

1747 (SC-RR-710212) NUMERICAL SOLUTIONS OF INTEGRAL EQUATIONS AND CURVE FITTING. Biggs, Frank; Amos, Donald E. (Sandia Labs., Albuquerque, N. Mex.). Sep 1971. 135p. Dep. NTIS.

1748 (SC-RR-710348) TABLES OF PERCENTAGE POINTS OF STANDARDIZED PEARSON DISTRIBUTIONS. Amos, Donald E.; Daniel, Sharon L. (Sandia Labs., Albuquerque, N. Mex.). Jul 1971. 480p. Dep. NTIS.

1749 (SC-RR-710635) TITANIUM CARBIDE–CARBON VAPORIZATION. Lynch, A. W.; Williams, C. H. (Sandia Labs., Albuquerque, N. Mex.). Sep 1971. 22p. Dep. NTIS.

1750 (SC-T-713070) MOTION OF A DISLOCATION IN THE FIELD OF A PRECIPITATE UNDER THE INFLUENCE OF A CONSTANT EXTERNAL STRESS. Maikova, E. P.; Predvoditelev, A. A. Translated by Pat Newman (Sandia Labs., Albuquerque, N. Mex.), from Fiz. Metal. Metalloved.; 31: No. 4, 866-71(1971). 14p. Dep. NTIS.

1751 (SC-T-713073) DESIGN OF A PROGRAM FOR GROWING SINGLE CRYSTALS DOPED WITH VOLATILE IMPURITIES. Vol'pyan, A. E.; Gnilov, S. V.; Nashel'skii, A. Ya. Translated by Pat Newman (Sandia Labs., Albuquerque, N. Mex.), from Tsvetn. Metal.; 44: No. 2, 50-2(1971). 8p. Dep. NTIS.

1752 (TID-25813) UNITED STATES ATOMIC ENERGY COMMISSION FINANCIAL REPORT, 1971. (Atomic Energy Commission, Washington, D. C.). 64p. Dep. NTIS.

1753 (TID-25833) U. S. STATUTES OF GENERAL INTEREST TO SECURITY OFFICERS IN THE ATOMIC ENERGY PROGRAM. Mayer, Ralph G. (Division of Security (AEC), Washington, D. C.). Jan 1970. 110p. GPO $1.00.

1754 (TID-25836) [USE OF MOLECULAR HYBRIDIZATION WITH RIBOSOMAL RNA TO EXPLORE DISTANT GENETIC RELATIONSHIPS]. [Columbia Univ., New York. Dept. of Human Genetics and Development]. [1971]. 17p. Dep. NTIS.

1755 (TID-25841) ECOMAP: A COMPUTER PROGRAM FOR MAPPING ECOLOGICAL DATA. Bonham, Charles D. (Colorado State Univ., Fort Collins. Dept. of Range Science). Aug 1971. Contract AT(11-1)-2115. 46p. Dep. NTIS.

1756 (TID-25843) GC SATELLITE DNA OF GECARCINUS LATERALIS: ISOLATION; NUCLEIC ACID CONSERVATION; AND TRANSCRIPTION. Graham, Dale Elliott (Tennessee Univ., Knoxville). Aug 1971. 169p. Dep. NTIS.
Thesis.

1757 (UCID-30016) BOUND: A ROUTINE TO BRACKET EXTREMA OF FUNCTIONS OF A SINGLE VARIABLE. Hausman, R. F. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). 8 Jul 1971. Contract W-7405-eng-48. 9p. Dep. NTIS.

1758 (UCID-30017) FITTER, FUNGUS, FUNNY: LINEAR LEAST-SQUARES CURVE FITTING OF WEIGHTED TABULAR DATA. Edwards, Arthur L. (California Univ., Livermore. Lawrence Radiation Lab.). 8 Jul 1971. Contract W-7405-eng-48. 23p. Dep. NTIS.

1759 (UCID-30019) LRLTRAN EXTENSIONS. Zwakenberg, R.; Engle, J.; Gotthoffer, D.; River, M. (California Univ., Livermore. Lawrence Radiation Lab.). 30 Jul 1971. Contract W-7405-eng-48. 17p. Dep. NTIS.

1760 (UCLA-12-840) STABILITY OF UNSATURATED METHYL ESTERS OF FATTY ACIDS ON SURFACES. Slawson, Vida; Mead, James F. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [1970]. Contract AT(04-1)-Gen-12. 16p. Dep. NTIS.

1761 (UCLA-12-842) ALPHA OXIDATION OF CEREBRONIC ACID IN BRAINS FROM SCORBUTIC AND ASCORBIC ACID-SUPPLEMENTED GUINEA PIGS. Mead, James F.; Hare, Roberta S. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [nd]. Contract AT(04-1)-Gen-12. 8p. Dep. NTIS.

1762 (UCLA-12-843) BIOSYNTHESIS OF UNSATURATED FATTY ACIDS BY BACILLI. III. UPTAKE AND UTILIZATION OF EXOGENOUS PALMITATE. Fulco, Armand J. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [1970]. Contract AT(04-1)-Gen-12. 43p. Dep. NTIS.

1763 (UCLA-12-844) BIOSYNTHESIS OF UNSATURATED FATTY ACIDS BY BACILLI. IV. TEMPERATURE-MEDIATED CONTROL MECHANISMS. Fulco, Armand J. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [1971]. Contract AT(04-1)-Gen-12. 42p. Dep. NTIS.

1764 (UCLA-34-P-172-3) AVERAGE NEAREST NEIGHBOR DISTANCES BETWEEN UNIFORMLY DISTRIBUTED FINITE PARTICLES. Bansal, P. P.; Ardell, A. J. (California Univ., Los Angeles. School of Engineering and Applied Science). Jul 1971. Contract AT(04-3)-34. 20p. Dep. NTIS.

1765 (UCRL-51096) TORSION AND EXTENSION OF ELASTIC-PLASTIC CYLINDRICAL TUBES. Prado, Manuel Enrique (California Univ., Livermore. Lawrence Radiation Lab.). 16 Aug 1971. Contract W-7405-eng-48. 83p. Dep. NTIS.

1766 (UCRL-Trans-10555) LOWER COMBUSTION LIMIT IN THE REACTION OF FLUORINE WITH HYDROGEN. Pariiskaya, A. V. Translated for Univ. of California Lawrence Livermore Lab., Livermore, from Arm. Khim. Zh.; 21: No. 7, 630-2 (1968). 5p. Dep. NTIS.

1767 (Y-1784) FABRICATION OF DISCONTINUOUS, HIGH-FIBER-CONTENT, ISOTROPIC CARBON–CARBON COMPOSITES. Lambdin, F.; Cook, J. L. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 7 Oct 1971. Contract W-7405-eng-26. 49p. Dep. NTIS.

1768 (Y-DA-3953) FABRICATION OF ISOTROPIC FIBROUS CARBON–CARBON COMPOSITES. Cook, J. L.; Lambdin, F.

(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 30 Oct 1970. Contract W-7405-eng-26. 16p. (CONF-701105-1). Dep. NTIS.

From Conference on continuum aspects of graphite design; Gatlinburg, Tenn. (9 Nov 1970).

1769 (YALE-2912-34) TRACE ELEMENTS IN NATURAL WATERS. Annual Progress Report, December 1, 1970-November 30, 1971. Turekian, Karl K. (Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics). 31 Aug 1971. Contract AT(30-1)-2912. 61p. Dep. NTIS.

Appendix 1

SCOPE AND SECTION ARRANGEMENT OF NUCLEAR SCIENCE ABSTRACTS

Introduction

This appendix defines the subject scope and arrangement of the literature in *Nuclear Science Abstracts (NSA)*. Broadly stated, the subject scope of *NSA* includes all of nuclear science and technology defined as follows:

> Nuclear science is the study of the production, properties, and phenonema of atomic nuclei, subatomic particles, gamma rays, and x rays.
>
> Nuclear technology is the application of nuclear science to other sciences and engineering, and conversely, the application of other sciences and engineering to the problems of nuclear science.

Part 1 identifies the 10 major fields of nuclear science and technology into which *NSA* is divided. Subdivisions are listed under each field. Each subdivision is followed by statements of specific subject interest. These statements have been prepared to show the exact range and limits of subject interest for selecting literature abstracted and indexed in *NSA*.

Part 2 identifies the extent of interest in the chemical elements.

An index to Part 1 begins on Appendix 19.

NSA covers reports, journals, books, patents, reviews, theses, conferences, and other similar literature. Selection is based on subject content; nothing is excluded solely on the basis of form, origin, or language. Some of the general practices followed in selecting literature for *NSA* are as follows:

1. Popular type articles are not included.
2. Textbooks below the graduate level are not included.
3. Theses below the doctoral level are not included.
4. Patents that have been filed in several countries are included only once.
5. Material existing only as abstracts or short summaries are not included except for papers summarized in the *Transactions of the American Nuclear Society*.
6. Material initially published in a language other than English may be included both when an item is published in the original language and when an item appears in an English language translation.
7. All U. S. Atomic Energy Commission research and development reports in printed form which have been made publicly available at the National Technical Information Service (NTIS) are included in *NSA*. Also included in *NSA* are the printed reports from the national nuclear energy organizations of the United Kingdom, Japan, Canada, Sweden, Denmark, Norway, Australia, and France which have been made publicly available at NTIS.
8. Related groups of engineering drawings and specifications are abstracted and indexed in *NSA* when they become publicly available.
9. As a general practice, material more than two years old is not included in *NSA*.

All journals scanned regularly are listed in Issue No. 1 of each new volume. New additions are listed in issues numbered 7, 13, and 19 of each volume.

Part 1

SCOPE AND ARRANGEMENT

1.0 CHEMISTRY

1.01 Analytical Chemistry

Chemical and Spectral Procedures

Involving the actinides or lanthanides, any radioactive element, other elements as specified in Part 2 (Extent of Interest in the Elements), or any element or compound when the application is directly associated with nuclear technology.

Isotopic Procedures

Under all conditions other than applications in geologic age determinations

Radiometric Procedures

Under all conditions other than routine tracer studies

Activation Procedures

1.02 Inorganic, Organic, and Physical Chemistry

Chemical properties of actinides, of actual or simulated fission products, or of any element, compound, or mixture when the application is directly associated with nuclear technology

Isotope effects on chemical properties and reactions

Physical chemistry and crystal structure of compounds and nonmetallic elements studied for use in connection with actual or simulated radiation environments. Structural studies in which radioisotopes are used as tools are excluded

1.03 Radiation and Nuclear Chemistry

Radiation effects on compounds and nonmetals

Radiation processes such as radioinduced polymerization or radiation catalysis

Radiolysis

Radioisotope production

See also Separation Processes and ENGINEERING—Isotope Technology

Recoil reaction mechanisms

1.04 Radiochemistry

Radiochemistry under any condition other than the preparation of labeled compounds

1.05 Separation Processes

Fuel processing and reprocessing, both radioisotope and reactor, under any condition

See also Radiochemistry

Chemical separation of isotopes other than analytical applications

See also Analytical Chemistry and ENGINEERING—Isotope Technology

Ore processing for thorium or uranium recovery

Waste processing for concentration, decontamination, or fission product recovery

2.0 EARTH SCIENCES

2.01 Geology and Hydrology

Movement and level of radioactive materials (fallout, natural radioactivity, or radioactive waste) in the earth, rivers, lakes, and streams

Radiometric techniques such as age estimations (geochronology) and well logging when the equipment and/or method is of primary concern, but *only* if the equipment is new or has been modified or an existing method has been developed or extended.

See also INSTRUMENTATION—Radiometric Instruments

Geological investigations pertinent to underground nuclear explosion technology nuclear facilities, and radioactive waste disposal or storage

2.02 Meteorology

Fallout transport and deposition

Radioactive aerosol and gas movement and dispersal

Radioactivity levels in the atmosphere

Surveys for nuclear facilities and nuclear explosion test sites

2.03 Mineralogy and Exploration

Identification, description, and estimated reserves of thorium and uranium minerals

2.04 Oceanography

Disposal of radioactive material in oceans and seas

Movement and levels of radioactive material in oceans and seas

2.05 Seismology

Nuclear explosion detection and identification systems

Seismological surveys for nuclear facilities

3.0 ENGINEERING

3.01 Nuclear Explosions

Use of nuclear (or simulated nuclear) explosions for the development of detection systems and techniques

Engineering developments and theoretical analyses associated with peaceful applications of nuclear explosions

3.02 Facilities and Equipment

Engineering studies (including economic) not specifically included in another category on the design, construction, and operation of irradiation facilities, laboratories, pilot plants, and other nuclear facilities and equipment

3.03 Heat Transfer and Fluid Flow

Theoretical or engineering studies of heat transfer and fluid flow applied to nuclear facilities, plants, or laboratories

For electrofluid mechanics and magnetofluid mechanics

See **PHYSICS (GENERAL)—Fluid Physics**

3.04 Isotope Technology

Design, development, fabrication, testing, and evaluation of radioisotopes as sources of heat, electricity or propulsion energy.

Design, development, fabrication, testing, and evaluation of radioisotope (including unseparated fission products) radiation sources

Physical separation of isotopes (centrifugal, electromagnetic, gaseous diffusion, and thermal diffusion)

See also **CHEMISTRY—Separation Processes**

3.05 Materials Testing

Equipment, methods, and techniques for destructive and nondestructive testing applied to nuclear technology

3.06 Protective Structures

Design, construction, and effectiveness of structures for protection against nuclear explosions and fallout

See also **LIFE SCIENCES—Health Physics and Safety**

3.07 Radioactive Material Handling

Equipment, facilities, procedures, accountability, and regulations for handling, shipping, storing, or concentrating radioactive materials

3.08 Vacuum Engineering

Design, construction, and operation of ultrahigh vacuum systems and equipment, i.e., 10^{-9} torr or greater. Does not include vacuum systems and equipment that are more appropriately categorized according to the application; e.g., a vacuum system specifically intended for an accelerator is included under **PHYSICS (HIGH ENERGY)—Particle Accelerators**

4.0 INSTRUMENTATION

4.01 Radiation Detection Instruments

General Detectors and Monitors

Nuclear Spectroscopic Instrumentation

High Energy Physics Instrumentation

4.02 Radiation Dosimeters

Design, testing, and theory

4.03 Radiometric Instruments

Design, testing, and theory of instruments which use radiation sources and detectors as means of measurement

4.04 Miscellaneous Instruments and Components

Design, performance, or testing for direct application in nuclear technology

4.05 Radiation Effects on Instruments and Instrument Components

5.0 LIFE SCIENCES

5.01 Biochemistry, Physiology, and Molecular Biology

Basic Processes

Elucidation by radioisotopes in biological materials at any level of organization if: the technique is new; the tracer has not been used previously in biological materials; new apparatus has been designed; or a new method for introducing the tracer is described (for design, testing, and theory of radiation instruments *see* **INSTRUMENTATION)**

Metabolism, Physiology, and Toxicology

All actinide elements, all fission products and any radioisotope if the radioisotope enters the biological material in elemental form or if an isotope effect is reported or discussed.

Radiation Effects

Effects of ionizing radiations (alpha and beta particles, electrons, protons, neutrons, accelerated ions, gamma and x radiation, charged mesons and ultraviolet light below 2537Å) and ultraviolet light, microwaves, high intensity radiation from lasers and all electromagnetic radiations to the extent that they mimic ionizing radiations on biological materials (enzymes, hormones, nucleic acids, cell nuclei, mitochondria, etc.) if a molecule or subcellular organelle is the level of interaction

Immunology

Reactions or responses of nonirradiated hosts to challenge by irradiated materials and reactions of irradiated hosts to challenge by nonirradiated materials (host includes organizational levels from the molecule to the entire organism)

For studies at the cellular level of organization *see* **Genetics and Cytogenetics; Radiation Effects on Animals; Radiation Effects on Plants; and Radiation Effects on Microorganisms**

5.02 Ecology

Movement and fate of radioisotopes, actinide elements, or fission products in animal and plant communities or ecosystems

Effects of ionizing radiations on plant and animal communities and on ecosystems

New techniques for radiologic study of ecosystems

Surveys for nuclear facilities and nuclear explosion test sites

Thermal effects on the environment. (Limited to considerations on or applicable to nuclear operations.)

5.03 Genetics and Cytogenetics

Radiation effects on hereditary characteristics and processes at all levels of organization (biochemical through organism) including radioinduced mutations and chromosome aberrations, and characteristics of radioinduced mutants (for somatic effects *see* **Radiation Effects on Plants** and **Radiation Effects on Animals**)

5.04 Health Physics and Safety

Radioactive Contamination and Decontamination

Internal and external
See also **ECOLOGY**

Dosimetry and Monitoring

Measurement, calculation, or estimation of dose from radiation sources (internal and external) to which biological materials are exposed or may be exposed
See also **INSTRUMENTATION—Radiation Detection Instruments**

Radiation Protection

Application and effectiveness of radiation protection by physical agents such as clothing, ointments, etc., other than bulk shielding
See also **ENGINEERING—Protective Structures**

Safety Procedures

Civil Defense

All phases of civil defense planning related to human engineering, including studies of survival in real or simulated post-attack environment

Legal Aspects

Legal aspects, excluding litigation, or activities of agencies and committees (at any level) in the protection of persons or groups of persons against real or anticipated radiation hazards

5.05 Medicine

Protective Substances

Evaluation of substances for protection against, enhancement of, or amelioration of radiation effects (includes animal research)

Radiation Sickness and Injuries

Treatment of radiation sickness and injuries in irradiated animals and man

Radiodiagnosis

New preparations or new or novel techniques

Radiotherapy

New preparations or new or novel techniques

Blast and Thermal Effects

Blast, thermal, and other effects of real or simulated nuclear explosions (includes studies of atomic bomb survivors)

5.06 Radiation Effects on Animals

Invertebrates

Effects (somatic or behavioral) of ionizing radiations, neutrons, accelerated particles, microwaves, ultraviolet light, or high intensity radiation from lasers

Vertebrates

Effects (somatic or behavioral) of ionizing radiations, neutrons, accelerated particles, microwaves, ultraviolet light, or high intensity radiation from lasers

Man

Effects (somatic or behavioral) of ionizing radiations, neutrons, accelerated particles, microwaves, ultraviolet light, or high intensity radiation from lasers

For effects of radiation on immune reactions and genetics, *see* **Biochemistry, Physiology,** and **Molecular Biology** and also **Genetics and Cytogenetics**

5.07 Radiation Effects on Plants

Effects (somatic or behavioral) of ionizing radiations, ultraviolet light, microwaves, or high intensity radiation from lasers on plants

For effects of radiation at the molecular and subcellular levels, *see* **Biochemistry, Physiology,** and **Molecular Biology**

For genetic effects of radiation, *see* **Genetics and Cytogenetics**

5.08 Radiation Effects on Microorganisms

Effects (somatic or behavioral) of ionizing radiations, neutrons, accelerated particles, ultraviolet light, microwaves, or high intensity radiation from lasers on bacteria, bacteriophages, rickettsia, and viruses

For effects of radiation on genetics of microorganisms, *see* **Genetics and Cytogenetics**

5.09 Radiosterilization and Radiopreservation

Use of ionizing radiations on food, pests, and materials such as medical or surgical supplies, vaccines, etc.

For irradiation facilities *see also* **ENGINEERING—Facilities and Equipment**

6.0 METALS, CERAMICS, AND OTHER MATERIALS

For interest in specific elements see **Part 2: Extent of Interest in the Elements**

6.01 Metals and Alloys

Corrosion and Erosion

Involving any metal or alloy under actual or simulated reactor, separation process, or waste disposal conditions

Preparation and Fabrication

For proposed or actual application in nuclear technology

Properties Evaluations

Involving application in accelerator, reactor, or other nuclear technology

Structure and Phase Studies

Metallurgical evaluations associated with nuclear-technology applications

Radiation Effects

6.02 Ceramics, Cermets, and Refractories

Corrosion and Erosion

Involving any ceramic or cermet under actual or simulated reactor, separation process, or waste disposal conditions

Preparation and Fabrication

Involving proposed or actual application in nuclear technology

Properties Evaluations

Involving application in accelerator, reactor, or other nuclear technology

Structure and Phase Studies

Evaluations associated with nuclear-technology applications

Radiation Effects

6.03 Plastics and Other Materials

Corrosion and erosion under actual or simulated reactor, separation process, or waste disposal conditions

Preparation and fabrication for proposed or actual application in nuclear technology

Properties evaluations involving applications in accelerator, reactor, or other nuclear technology

Structure and phase studies associated with evaluations for nuclear-technology applications

Radiation effects

7.0 PHYSICS (GENERAL)

7.01 Astrophysics and Cosmology

Cosmic-ray Exposure Ages

Includes elemental abundance from studies of meteorites, chondrites, etc.

Stars

Composition, evolution, physical conditions, and nucleogenesis

Quasi-Stellar, Radio, and X-Ray Sources

Quasi-stellar sources, blue stellar objects, radiogalaxies, and Seyfert galaxies (theory and detailed studies only, not reports on the location of the objects)

Solar phenomena

Sunspots, prominences, disturbances, solar wind, solar flares, radio bursts, and magnetic field effects; origin of the solar system; and structure and spectra of the sun

Galaxies

Structure, interstellar matter, x-ray sources, H II regions, etc., only as related to radiations, nuclear phenomena, and plasma physics, not celestial mechanics

Cosmology

Structure and evolution of the Universe in the large

Planetary phenomena

Radiation belts (other than van Allen, for which *see* **Geophysics**), interplanetary magnetic fields, and radioemissions only

7.02 Atomic and Molecular Physics

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Reactions with materials

Atomic and Molecular Properties

Of hydrogen, helium, the actinides, and the lanthanides

Positronium, Muonium, and Mesic Atoms and Molecules

Does not include positron annihilation when used strictly for structural studies

Collision Phenomena

Charge-exchange, excitation, or dissociation phenomena involving electrons, ions, atoms, or molecules

Atomic Theory

For general application; not when exclusively applied to or developed for a specific element

7.03 Cosmic Radiation

All scientific and technical aspects except interactions with the earth's magnetic field, for which *see* **Geophysics**, and biological effects, for which *see* **LIFE SCIENCES**

7.04 Direct Energy Conversion

Magnetofluidmechanic, plasma, and thermionic devices and applications of thermoelectric devices to reactor or other nuclear facilities, and nuclear phenomena or techniques

7.05 Fluid Physics

Electrofluidmechanics
Magnetofluidmechanics

7.06 Geophysics (Upper Atmosphere)

Auroral or ionospheric phenomena only when particle kinetics are discussed

Nuclear detonations and their effects

Particle kinetics and geomagnetic trapping in van Allen radiation belts.

Particle phenomena resulting from solar-wind or cosmic ray interactions with the earth's magnetic field

7.07 Low-Temperature Physics

Superconductivity and superfluidity

Other cryogenic studies and equipment if nuclear phenomena or techniques are involved

7.08 Plasma and Thermonuclear Physics

(Does not include antenna studies)

Confinement and Heating of Plasma

Diagnostics of Plasma

Kinetics (General)

Kinetics (Experimental)

Kinetics (Theoretical)

Production

Stability

Thermonuclear Processes

Wave Phenomena

7.09 RADIATION PHYSICS AND SHIELDING

Radiation Physics

Basic interactions of photons or charged particles with matter, including, e.g., stopping power, range, slowing down, specific ionization, energy transfer, and basic transport theory (except for neutron transport, see PHYSICS (NUCLEAR)).

Shielding

Physics of shielding against ionizing radiation, neutrons, and accelerated particles. For applied shielding see sections covering the application; for shield fabrication *see* **Metals, Ceramics, and Other Materials**

7.10 Solid-State Physics

Radiation Effects

On crystallographic or electronic properties of solids

Physical Properties

Of actinides, lanthanides, and other elements of special metallurgical interest in nuclear technology

Moessbauer Effects and Nuclear Magnetic Resonance

In actinides, lanthanides, or other elements of special metallurgical interest in nuclear technology or if a contribution is made to the technique (if nuclear properties are determined, *see* **PHYSICS (NUCLEAR)**)

Theory

7.11 Theoretical Physics

General quantum theory

See also **PHYSICS (HIGH-ENERGY)—Field Theories**

Mathematical physics directly related to nuclear science and technology

8.0 PHYSICS (HIGH ENERGY)

8.01 Particle Interactions and Properties (Experimental)

Includes all experimental studies on the electromagnetic, weak, and strong interactions and properties of particles and radiation quanta and experimental information on hyperfragments (hypernuclei) and particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV) under the following subcategories:

Electromagnetic

Weak

Strong (Baryon-Induced)

Strong (Meson-Induced)

8.02 Particle Interactions and Properties (Theoretical)

Includes all theoretical studies on the electromagnetic, weak, and strong interactions and properties of particles and radiation quanta and theoretical information on hyperfragments (hypernuclei) and particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV) under the following subcategories:

General

Electromagnetic

Weak

Strong (General)

Strong (Baryon No. = 0)

Strong (Baryon No. = 1)

Strong (Baryon No. ⩾2)

8.03 Particle Invariance Principles and Symmetries

Includes information on the space-time symmetries and internal symmetries of particles and the applications of these symmetries to the electromagnetic, weak, and strong interactions under the following subcategories:

General

Applications to Electromagnetic and Weak Interactions

Applications to Strong Interactions

8.04 Field Theories

Includes all information on quantum field theories, quantum electrodynamics, relativistic quantum mechanics and special relativity theory, and gravitation and general relativity theory under the following subcategories:

General

Quantum Field Theory and Relativistic Mechanics

Gravitation and General Relativity Theory

8.05 Scattering Theory

Includes general scattering theory only. Information on the application of scattering theory to specific interactions of particles or types of particles is found under other subcategories according to type of interaction (i.e., electromagnetic, weak, or strong)

8.06 Particle Accelerators

Design, development, and operation, auxiliaries and components, ion sources, injection and extraction systems, ion optics and field calculations, storage rings, and experimental facilities (including radiation targets)

9.0 PHYSICS (NUCLEAR)

9.01 Neutron Interactions with Matter

Experimental and theoretical studies of neutron absorption, scattering, thermalization, transport, etc., in macroscopic systems, including solution of the neutron transport equation and theoretical neutron transport in matter in general geometric configurations

Production and calibration of neutron sources

9.02 Nuclear Properties and Reactions, $A \leq 5$, $6 \leq A \leq 19$, $20 \leq A \leq 89$, $A \geq 90$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission

Model calculations for specific nuclei

9.03 Nuclear Theory

Nuclear structure, nuclear matter, nuclear reactions and scattering, nuclear moments and spin, radioactive decay, spontaneous and induced fission, and nuclear models

10.0 REACTOR TECHNOLOGY

10.01 Commercial Power Reactors

Kinetics and dynamics, control systems, shielding, cooling systems, fuels, auxiliary and emergency systems, operation and economics, safety and siting, and steam and power conversion systems

10.02 Power Reactor Development

Kinetics and Dynamics

Control Systems

Shielding

Cooling Systems

Fuels

Auxiliary and Emergency Systems

Operation and Economics

Safety and Siting

Power Conversion Systems

10.03 Research and Test Reactors

Kinetics and dynamics, control systems, shielding, cooling systems, fuels, auxiliary and emergency systems, operation, safety and siting, and test facilities

10.04 Rocket and Space Reactors

Kinetics and dynamics, control systems, shielding, cooling systems, fuels, auxiliary and emergency systems, operation, safety, and power conversion systems

10.05 Process Heat and Desalination Reactors

Kinetics and dynamics, control systems, shielding, cooling systems, fuels, auxiliary and emergency systems, operation and economics, safety and siting, and power conversion systems

10.06 Marine and Portable Power Reactors

Kinetics and dynamics, control systems, shielding, cooling systems, fuels, auxiliary and emergency systems, operation and economics, safety, and power conversion systems

10.07 Production Reactors

Shielding, operation and performance, and safety and radiation hazards

10.08 Reactor Theory

Kinetics

Dynamics

Experimental Applications

10.09 Reactor Components, Fuels, and Accessories

(Where no type is specified)

11.0 GENERAL

Publicly available annual administrative and research and development reports from the United States Atomic Energy Commission and the national nuclear energy organizations of the United Kingdom, Canada, Sweden, Denmark, Japan, Australia, France, and Norway which are outside the subject scope of other categories.

Part 2

EXTENT OF INTEREST IN THE ELEMENTS

ACTINIUM
All scientific and technical aspects

ALUMINUM
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

AMERICIUM
All scientific and technical aspects

ANTIMONY
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARGON
Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARSENIC
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ASTATINE
All scientific and technical aspects

BARIUM
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

BERKELIUM
All scientific and technical aspects

BERYLLIUM
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state physics

BISMUTH
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of liquid bismuth
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

BORON
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steel containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

BROMINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CADMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steel containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

CALCIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CALIFORNIUM

All scientific and technical aspects

CARBON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, it compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Properties and fabrication of nuclear-grade graphite and graphite fuel materials

Radiation effects

Radiochemistry

CERIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

CESIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CHLORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine application as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CHROMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

COBALT

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element,

its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

COPPER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CURIUM

All scientific and technical aspects

DYSPROSIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application) compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

EINSTEINIUM

All scientific and technical aspects

ERBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

EUROPIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

FERMIUM

All scientific and technical aspects

FLUORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

FRANCIUM

All scientific and technical aspects

GADOLINIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

GALLIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

GERMANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

GOLD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

HAFNIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

HELIUM

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Superfluidity

HOLMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

HYDROGEN

Applications of the element or its compounds and systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of deuterium and tritium

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

INDIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

IODINE

Analysis, determination, and separation

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

IRIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

IRON

Applications of the element and its alloys or systems, including steel and stainless steel, in nuclear technology or the behavior of the element, its alloys, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

KRYPTON

Analysis, determination, and separation

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

LANTHANUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

LAWRENCIUM (103)

All scientific and technical information

LEAD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

LITHIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

LUTETIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

MAGNESIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MANGANESE

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MENDELEVIUM

All scientific and technical aspects

MERCURY

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MOLYBDENUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

NEODYMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys, compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

NEON

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NEPTUNIUM

All scientific and technical aspects

NICKEL

Applications of the element or its alloys, compounds, or systems, in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NIOBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

NITROGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NOBELIUM

All scientific and technical aspects

OSMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

OXYGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PALLADIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PHOSPHORUS

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PLATINUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PLUTONIUM

All scientific and technical aspects

POLONIUM

All scientific and technical aspects

POTASSIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PRASEODYMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

PROMETHIUM

All scientific and technical aspects

PROTACTINIUM

All scientific and technical aspects

RADIUM

All scientific and technical aspects

RADON

All scientific and technical aspects

RHENIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

RHODIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

RUBIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

RUTHENIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SAMARIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state physics

SCANDIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

SELENIUM

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SILICON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SILVER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SODIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of liquid sodium in cooling systems
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

STRONTIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SULFUR

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

TANTALUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

TECHNETIUM

All scientific and technical aspects

TELLURIUM

Analysis, determination, and separation

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

TERBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Radiation effects

Radiochemistry

Solid-state physics

THALLIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

THORIUM

All scientific and technical aspects except mining and routine industrial uses, e.g., thoriated cathodes

THULIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

TIN

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

TITANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

TRANSLAWRENCIUM ELEMENTS

All scientific and technical aspects

TUNGSTEN

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

URANIUM

All scientific and technical aspects except mining and routine industrial applications

VANADIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element,

its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

XENON

Analysis, determination, and separation

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

YTTERBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

YTTRIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

ZINC

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

ZIRCONIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

Part 3
INDEX

The entries in this index are to numbered paragraphs in Part 1: Scope and Arrangement or to Part 2: Extent of Interest in the Elements.

Accelerators, 8.06
Accident analyses, 5.04
Actinides, all aspects except mining and routine industrial uses
Activation analysis, 1.01
Aerosols, radioactive only, 2.02
Age determination, cosmic-ray exposure ages, 7.01
on geologic materials, 2.01
Aircraft reactors, 10.04
Alloys and metals, 6.01
see also **Extent of Interest in the Elements** for interest in specific metallic elements and their alloys
Analytical chemistry, 1.01
see also **Extent of Interest in the Elements** for interest in analysis of specific elements
Animals, radiation effects on, 5.06
Astrophysics, 9.01
Atmospheric nuclear explosions, 3.01, 5.05, 7.06
Atmospheric radioactivity, 2.02
Atomic-beam reactions, 7.02
Atomic-explosion survivors, 5.04
Atomic explosions, detection systems development, 3.01
effects on organisms, 5.05
peaceful applications, 3.01
protective structures, 3.06
seismic detection, 2.05
technology, 3.01
test site surveys, 2.01, 2.02, 5.02
Atomic physics, 7.02
Atomic properties, 7.02
see also **Extent of Interest in the Elements**
Atomic theory, 7.02
Atoms–collision, charge-exchange, excitation, or dissociation phenomena, 7.02
Auroral phenomena, 7.06
Bacteria, radiation effects on, 5.08
Bacteriophages, radiation effects on, 5.08
Baryon interactions and properties, 8.0
Betatrons, 8.06
Binding energy of nuclei, 9.02
Biochemistry, 5.01
Biology, 5.0
Blast effects, 5.05
Blast shelters, 3.06
Blue stellar objects, 7.01
Catalysis, radioinduced cells, radiation effects on, 5.06, 5.07, 5.08
Cellular organelles, radiation effects on, 5.01
Central power reactors, 10.01, 10.02
Centrifugal separation of isotopes, 3.04
Ceramics and cermets, 6.02
Charge distribution, nuclei, 9.02
Charge-exchange phenomena, 7.02
Chemistry, 1.0
Chondrites, cosmic-ray exposure ages, 7.01
Chromosome aberrations, 5.03
Civil defense, engineering studies, 3.06
Civil defense planning, 5.04
Clothing, protective, 5.04
Collision of nuclear particles, 8.01, 8.02
Collision phenomena of electrons, ions, atoms, and molecules, 7.02
Commercial power reactors, 10.01
Compounds
see **Extent of Interest in the Elements** for interest in compounds of specific elements
Computers and codes only as applicable to the solutions of problems in nuclear science and technology
see entries in this index for the specific applications
Contamination, radioactive, 5.04
Control rods and systems, reactor, 10.0
Cooling systems, reactor, 10.0
Corrosion of materials of nuclear interest, 6.0
Cosmic radiation biological effects, 5.01
interactions with earth's magnetic field, 7.06
origin and other aspects, 7.03
Cosmic-ray exposure ages, 7.01
Cosmology, 7.01
Critical assemblies, 10.0
Criticality, reactor, 10.0
Cryogenics, 7.07
Crystal structure, compounds and nonmetallic elements, 1.02
Crystallographic properties, 7.10
Crystallography and crystal structure, 6.0
Cyclotrons, 8.06
Cytogenetics, 5.03
Decay, radioactive, 9.02
Decontamination of other than wastes, 5.04
Decontamination of radioactive wastes, 1.05
Desalination reactors, 10.05
Destructive materials testing, 3.05
Deuterium
see Hydrogen in **Extent of Interest in the Elements**
Direct energy conversion, 7.04
Dissociation phenomena of electrons, ions, atoms, and molecules, 7.02
Dosimeters, 4.02
Dosimetry, 5.04
Drugs for protection against, enhancement of, or amelioration of radiation effects, 5.05
Earth sciences, 2.0
Earth's magnetic fields, 7.06
Ecology, 5.02
Electrofluidmechanics, 7.05
Electromagnetic interactions, 8.01, 8.02, 8.03

Electromagnetic separation of isotopes, 3.04
Electron-beam reactions, 7.02
Electronic properties of solids, 7.10
Electrons, collision, charge-exchange, excitation or dissociation phenomena, 7.02
Elementary particles, 8.0
Elements, cosmic abundance, 7.01
see also **Extent of Interest in the Elements**
Energy conversion, direct, 7.04
Engineering, 3.0
Enzymes, radiation effects, 5.01
Equipment, 3.02
Erosion of materials of nuclear interest, 6.0
Euglena, radiation effects on, 5.07
Excitation phenomena of electrons, ions, atoms, and molecules, 7.02
Explosions, atomic, detection systems development, 3.01
effects on organisms, 5.05
peaceful applications, 3.01
protective structures, 3.06
seismic detection, 2.05
technology, 3.01
test site surveys, 2.01, 2.02, 5.02
Extragalactic objects, 7.01
Fabrication of materials of nuclear interest, 6.0
Fallout, contamination and radiation dosage from, 5.04
in the environment, 2.01, 2.02, 2.04
shelters, 3.06, 5.04
Field theory, 8.04
Fission, 9.02, 9.03
Fission products, chemistry, 1.0
distribution and transport in the environment, 2.01, 2.02, 2.04
effect on ecosystems, 5.02
metabolism, toxicology, and physiology, 5.01
recovery, 1.05
utilization, 3.04
Fluid flow, 3.03
Fluid physics (electrofluid mechanics and magnetofluid mechanics), 7.05
Food preservation, 5.09
Fuel elements, reactor, 10.0
Fuel processing and reprocessing, 1.05
Fuel resources, 2.03
Galaxies, 7.01
Gas dispersal, radioactive, 2.02
Gaseous diffusion separation of isotopes, 3.04
General relativity theory, 8.04
Genetics, 5.03
Geological age estimations, 2.01
new isotopic analysis techniques, 1.01
Geology, 2.01
Geomagnetic trapping of particles, 7.06
Geophysics, 7.06
Graphite
see Carbon in **Extent of Interest in the Elements**
Gravitation and general relativity theory, 8.04
Health physics, 5.04
Heat sources, radioisotope, 3.04
Heat transfer, 3.03
in reactors, 10.0
High altitude effects of nuclear explosions, 7.06
High energy physics, 8.0
High energy physics instruments, 4.01
High temperature materials, 6.0
Hormones, radiation effects, 5.01
Human engineering aspects of civil defense, 5.04
Hydrology, 2.01
Hyperfragments, 8.01, 8.02
Hyperon interactions and properties, 8.0
Immune reactions, radiation effects on, 5.01
Industrial reactors, 10.0
Industrial safety, 5.04
Infrared radiation, effects of, from nuclear explosions, 5.05
Injection systems for accelerators, 8.06
Inorganic chemistry, 1.02
Instruments and components, 4.0
Interactions of particles, 8.01, 8.02
Internal symmetries of particles, 8.03
Interplanetary magnetic fields, 7.01
Interplanetary space, 7.01
Interstellar space and matter, 7.01
Invariance principles, 8.03
Ion beam reactions, 7.02
Ion optics, 8.06
Ion sources, 8.06
Ionospheric phenomena, 7.06
Ions; collision, charge-exchange, excitation, or dissociation phenomena, 7.02
Irradiation facilities, 3.02, 5.09
Isotope effects, 1.02, 5.01
Isotope production, 1.03
Isotope separation, 1.05, 3.04
Isotope therapy, 5.05
see **Extent of Interest in the Elements** for interest in isotopes of specific elements
Isotopic analysis, 1.01
Isotopic power sources, 3.04
Isotopic tracer studies, only if the technique is new. (See the area of application.)
Labeled compound preparation (exclusion), 1.04
Laboratories, engineering studies, 3.02
Laboratory and plant equipment, 3.02
Lakes, fallout in, 2.01
Lanthanides, analytical chemistry, 1.01
physical properties, 7.10
see also **Extent of Interest in the Elements** for interest in specific lanthanides
Laser radiation, biological effects and medical uses, 5.0
Legal aspects of nuclear energy, 5.04
Lepton interactions and properties, 8.0
Limnology, 2.01, 5.02, 5.04
Low-temperature physics, 7.07
Magnetic field of the earth, 7.06
Magnetic fields, interplanetary, 7.01
Magnetofluidmechanic devices, 7.04
Magnetofluidmechanics, 7.05
Marine reactors, 10.02
Mass of nuclei, 9.02
Mass spectrometers for isotope separation, 3.04
Materials handling, radioactive, 3.07
Materials testing, 3.05, 6.0
Mathematical physics, 7.11
Mathematics only as applicable to the solution of problems in nuclear science and technology
see the areas of application
Medicine, 5.05
Mesic atoms and molecules, 7.02
Meson interactions and particles, 8.0
Metabolism, 5.01
see also **Extent of Interest in the Elements** for interest in metabolism of specific elements

Metallurgy, 6.01
see also **Extent of Interest in the Elements** for interest in specific metallic elements
Meteorites, comsic-ray exposure ages, 7.01
Meteorology, 2.02
Microorganisms, radiation effects on, 5.08
Microwaves, biological effects, 5.01, 5.03, 5.06, 5.07, 5.08
Mineralogy of thorium and uranium, 2.03
Mitochondria, radiation effects on, 5.01
Moessbauer effect, 7.10, 9.0
Molecular beam reactions, 7.02
Molecular biology, 5.01
Molecular physics, 7.02
Molecular properties of actinides and transuranic elements, 7.02
Molecules; collision, charge-exchange, excitation, or dissociation phenomena, 7.02
Molten materials, 6.0
Moments of nuclei, 9.02
Monitors, radiation, 4.01
Muonium, 7.02
Mutants and mutations, radioinduced, 5.03
Natural radioactivity, 2.01
Neoplasm radiotherapy, 5.05
Neutron activation analysis, 1.01
Neutron-diffraction analysis as applicable to materials of nuclear interest
see **Extent of Interest in the Elements**
Neutron interaction with matter, 9.01
Neutron scattering law, 9.01
Neutron sources, 9.01
Neutron transport equation, 9.01
Nondestructive testing applied to nuclear technology, 3.05
Nuclear binding energy, 9.02
Nuclear charge distribution, 9.02
Nuclear chemistry, 1.03
Nuclear detonations, 7.06
Nuclear energy levels and transitions, 9.02
Nuclear explosions, detection systems development, 3.01
effects on organisms, 5.05
peaceful applications, 3.01
protective structures, 3.06
seismic detection, 2.05
technology, 3.01
test site surveys, 2.01, 2.02
Nuclear facilities, 3.02
Nuclear-facility site surveys, 2.01, 2.02, 2.05
Nuclear magnetic resonances, 7.10
Nuclear mass of specific nuclei, 9.02
Nuclear matter, theory, 9.03
Nuclear model calculations for specific nuclei, 9.02
Nuclear models, theory, 9.03
Nuclear moments, 9.02, 9.03
Nuclear phenomena in direct energy conversion, 7.04
Nuclear physics, 7.0, 8.0, 9.0
Nuclear reactions, 9.02, 9.03
high energy, 8.0
Nuclear rockets, 10.04
Nuclear spin, 9.02, 9.03
Nuclear structure, 9.03
Nuclear theory, 9.03
Nucleic acids, radiation effects, 5.01
Oceanography, 2.04
Ore processing for thorium or uranium recovery, 1.05
Organic chemistry, 1.02
Particle accelerators, 8.06
Particle collision, nonnuclear, 7.02
Particle extraction systems (accelerators), 8.06
Particle interactions, 8.01, 8.02
Particle invariance principles and symmetries, 8.03
Particle kinetics in radiation belts, 7.06
Particle symmetries, 8.03
Permissible limits on radiation, 5.04
Personnel shelters, 3.06
Phase studies of materials, 6.0
Physical chemistry, 1.02
Physics, 7.0, 8.0, 9.0
Physiological processes, 5.0
Pilot plant studies, 3.02
Planetary phenomena, 7.01
Plants (vegetation), radiation effects on, 5.07
Plasma devices, 7.04
Plasma physics, 7.08
Plowshare program, 3.01
Plutonium production reactors, 10.06
Polymerization, radioinduced, 1.03
Portable reactors, 10.03
Positronium, 7.02
Power plants, nuclear reactor, 10.01, 10.02, 10.03, 10.04
Power reactors, 10.01, 10.02, 10.03
Power sources, radioactive, 3.04
Preservation of foods, 5.09
Process heat reactors, 10.05
Production reactors, 10.07
Prophylactic drugs, 5.05
Protective clothing, 5.04
Protective structures, 3.06, 5.04
Quantum electrodynamics, 8.04
Quantum field theories, 8.04
Quantum theory, general, 7.11
Quasi-stellar sources, 7.01
Radiation belts other than van Allen, 7.01
Radiation belts, van Allen, 7.06
Radiation, cosmic, 7.03
Radiation chemistry, 1.03
Radiation detection instruments, 4.01
Radiation dose calculation or measurement, 5.04
Radiation dose limitations, 5.04
Radiation dosimeters, 4.02
Radiation effects, on animals, 5.06
on ceramics and cermets, 6.02
on compounds and nonmetals, 1.03
on ecosystems, 5.02
on hereditary characteristics, 5.03
on immune reactions, 5.01
on instruments, 4.05
on metals, 6.01
on microorganisms, 5.08
on nonmetals, 1.03
on plants, 5.07
on plastics and other materials, 6.03
on reactor fuels, 6.01, 6.02
on solids, 1.03, 6.0, 7.10
on subcellular biological materials, 5.01
Radiation hazards, 5.04
from reactors, 10.0
Radiation monitors, 4.01
Radiation protection, biological and chemical agents, 5.05
legal aspects, 5.04
fallout and nuclear explosions, 5.04
physical agents, 5.04
Radiation shielding materials, 7.09, 10.0
Radiation sickness, 5.04, 5.05, 5.06
Radiation source production and measurement, 9.01

Radiation sources, isotopes for, 3.04
Radiation targets, 8.06
Radioactive aerosols and gases, 2.02
Radioactive contamination, 5.04
Radioactive decay, 9.02, 9.03
Radioactive material storage facilities, 3.07
Radioactive materials concentration, 3.07
Radioactive wastes, 1.05, 2.01, 2.02, 2.04, 3.02, 5.04
Radioactivity in the environment, 2.02, 5.04
Radioastronomy, 7.01
Radiochemistry, 1.04
Radiodiagnosis, 5.05
Radiography, 3.05, 5.05
Radioinduced mutations, 5.03
Radioinduced polymerization, 1.03
Radioisotopes, dose measurements, 5.04
effects on organisms, 5.0
production, 1.03
technology, 3.04
therapy, 5.05
toxicology, 5.01
transport and effects on ecosystems, 5.02
Radiolysis, 1.03
Radiometric analysis, 1.01
Radiometric instruments, 4.03
Radiometric techniques, 2.01
Radiopreservation, 5.09
Radioprotective compounds, 5.05
Radiosensitizers, 5.05
Radiosterilization, 5.09
Radiotherapy and diagnosis, 5.05
injuries induced by, 5.06
Ramjets, nuclear, 10.04
Rare earths
see **Extent of Interest in the Elements** or interest in specific rare earths
Reactivity of reactors, 10.0
Reactor auxiliaries and components, 10.0
Reactor economics, 10.0
Reactor fuel processing and reprocessing, 1.05
Reactor fuels, 10.0
Reactor safety, 10.0
Reactor shielding, 10.0
Reactor theory, 10.08
Recoil reactions, 1.03
Refractories, 6.02
Relativistic quantum mechanics, 8.04
Relativity theory, 8.04
Remote control and remote viewing devices, 3.02
Research reactors, 10.03
Rickettsia, radiation effects on, 5.05
Rivers, fallout in, 2.01, 5.04
Rocket reactors, 10.04
Rockets, nuclear, 10.04
Safety regulations, 5.04
Satellites, nuclear power systems, 3.04, 10.04
Scattering of particles by nuclei, 9.02
Scattering theory, elementary particle, 8.05
nuclear, 9.03
Seismology for nuclear explosion and nuclear facility site surveys, 2.05
Separation processes, 1.05, 3.04
materials for, 6.0
Seyfert galaxies, 7.01
Shelters, blast and fallout, 3.06
Shielding, radiation, 5.04, 7.0, 10.0
Shipboard reactor, 10.06
Shipping of radioactive material, 3.07
Site surveys, 2.01, 2.02, 2.05, 10.0
Solar phenomena, 7.01
Solar-wind interactions with geomagnetic field, 7.06
Solid-state physics, 7.10
see also **Extent of Interest in the Elements**
Space, 7.01
Space propulsion, isotopes, 3.04
Space reactors, 10.03
Space-time symmetries of particles, 8.03
Spectrometers, 4.01
Spin of nuclei, 9.02
Stack removal methods, 5.04, 1.05
Stars, 7.01
Sterilization by radiation, 5.09
Storage facilities for radioactive materials, 3.07, 5.04
Storage rings, accelerator, 8.06
Streams, fallout in, 2.01
Strong interactions, 8.01, 8.02
Structures for nuclear explosion and fallout protection, 3.06, 5.04
Sunspots, 7.01
Superconductivity and superconductors, 7.07
Survival studies, 5.04
Symmetry theory, 8.03
Synchrotrons, 8.06
Targets, radiation, 8.06
Test reactors, 10.06
Theoretical physics, 7.11
Therapy of radiation injuries and therapy by radiation, 5.05
Thermal diffusion separation of isotopes, 3.04
Thermal effects of nuclear explosions, 5.05
Thermionic devices, 7.04
Thermoelectric devices, 7.04
Thermonuclear explosions, 3.01
Thermonuclear reactors and reactions, 7.08
Thorium minerals, 2.03
Thorium separation and recovery, 1.05
Toxicology of radioisotopes, 5.01
Tracer techniques, new
see entries in this index for the application of the technique
Transport theory, neutron, 9.01
Transuranic elements, all aspects
Tritium
see **Hydrogen in Extent of Interest in the Elements**
Underground explosions, 2.01, 2.02, 3.01
Underground structures, 3.06
Underwater explosions, 2.01, 2.02, 2.04, 3.01
Uranium minerals, 1.05, 2.03
Uranium separation and recovery, 1.05
Vacuum technology, 3.08
Viruses, radiation effects on, 5.08
Waste disposal, marine, 2.04
site survey for, 2.01, 2.05
stack, 2.02, 5.04
storage, 3.07
Waste disposal sites, 2.01
Waste processing, 1.05
Weak interactions, 8.01, 8.02
X-ray sources, galactic, 7.01

Appendix II

JOURNAL LIST

Journals from which articles have been abstracted and indexed in *NSA* are listed here alphabetically by title abbreviation. The list will be supplemented in issue numbers 7, 13, and 19 of this volume.

The foreign language journals in this list available in English language translation are indicated and the title of the English language journal is included.

The title abbreviations are based on the National Clearinghouse for Periodical Title Word Abbreviations, *Word Abbreviation List* published by the Standards Committee Z-39 of the American National Standards Institute.

TID-4579 (5th Ed.) *Serial Titles Cited in Nuclear Science Abstracts* lists the titles and abbreviations of the journals regularly scanned for *NSA* as well as those from which an occasional item is taken. This publication is available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22151, for $6.00 for full size or reproduction copy and $0.95 for microfiche copy.

A

Acad. Roy. Belg., Cl. Sci., Mem., Collect. 8
Academie Royale de Belgique, Classe des Sciences, Memoires, Collection in 8 (Formerly carried as Memoires, Academie Royale des Belgique, Classe des Sciences, Collection in 8 (Belgium)

Accounts Chem. Res.
Accounts of Chemical Research (U.S.)

Acier
Acier-Stahl-Steel (Belgium)

Acta Acad. Abo., Ser. B
Acta Academae Aboensis, Series B, Mathematica et Physica (Finland)

Acta Agr. Scand.
Acta Agriculturae Scandinavica (Sweden)

Acta Anat.
Acta Anatomica (Switzerland)

Acta Biol. Med. (Gdansk)
Acta Biologica et Medica (Gdansk) (Poland)

Acta Biol. Med. Ger.
Acta Biologica et Medica Germanica (East Germany)

Acta Chem. Scand.
Acta Chemica Scandinavica (Denmark)

Acta Chim. Acad. Sci. Hung.
Acta Chimica Academiae Scientiarum Hungaricae (Hungary)

Acta Cient.
Acta Cientifica (Argentina)

Acta Cient. Venez.
Acta Cientifica Venezolana (Venezuela)

Acta Crystallogr., Sect. A
Acta Crystallographica, Section A. Crystal Physics, Diffraction, Theoretical and General Crystallography (Continues in Part Acta Crystallographica) (Denmark)

Acta Crystallogr., Sect. B
Acta Crystallographica, Section B. Structural Crystallography and Crystal Chemistry (Continues in Part Acta Crystallographica) (Denmark)

Acta Cytol.
Acta Cytologica (U.S.)

Acta Endocrinol.
Acta Endocrinologica (Denmark)

Acta Entomol. Bohemoslov.
Acta Entomologica Bohemoslovaca (Czechoslovakia)

Acta Fac. Rerum Natur. Univ. Comenianae, Phys.
Acta Facultatis Rerum Naturalium Universitatis Comenianae, Physica (Czechoslovakia)

Acta Geophys. Pol.
Acta Geophysica Polonica (Poland)

Acta Histochem.
Acta Histochemica (East Germany)

Acta Histochem., Suppl.
Acta Histochemica, Supplementband (East Germany)

Acta Iber. Radiol.-Cancerol.
Acta Iberica Radiologica-Cancerologica (Spain)

Acta Isotop.
Acta Isotopica (Italy)

Acta Math. (Uppsala)
Acta Mathematica (Uppsala) (Sweden)

Acta Med. Iugoslav.
Acta Medica Iugoslavica

Acta Med. Scand.
Acta Medica Scandinavica (Sweden)

Acta Med. Scand., Suppl.
Acta Medica Scandinavica, Supplement (Sweden)

Acta Met.
Acta Metallurgica (U.S.)

Acta Microbiol. Pol., Ser. A
Acta Microbiologica Polonica, Series A. Microbiologia Generalis (Poland)

Acta Microbiol. Pol., Ser. B
Acta Microbiologica Polonica, Series B. Microbiologia Applicata (Poland)

Acta Neurochir.
Acta Neurochirurgica (Austria)

Acta Neurol. (Naples)
Acta Neurologica (Naples) (Italy)

Acta Neurol. Scand.
Acta Neurologica Scandinavica. (Denmark)

Acta Neurol. Scand., Suppl.
Acta Neurologica Scandinavica, Supplementum. (Denmark)

Acta Neuropathol.
Acta Neuropathologica (Germany)

Acta Odontol. Scand.
Acta Odontologica Scandinavica (Sweden)

Acta Oncol.
Acta Oncologica (Spain)

Acta Orthop. Scand.
Acta Orthopaedica Scandinavica (Denmark)

Acta Oto-Laryngol.
Acta Oto-Laryngologica (Sweden)

Acta Pathol. Microbiol. Scand.
Acta Pathologica et Microbiologica Scandinavica (Denmark)
Divided into Sections A and B

Acta Pathol. Microbiol. Scand., Sect. A
Acta Pathologica et Microbiologica Scandinavica, Section A. Pathology (Denmark)

Acta Pharm. Hung.
Acta Pharmaceutica Hungarica (Hungary)

Acta Phys. Acad. Sci. Hung.
Acta Physica Academiae Scientiarum Hungaricae (Hungary)

Acta Phys. Austr.
Acta Physica Austriaca (Austria)

Acta Phys. Austr., Suppl.
Acta Physica Austriaca, Supplementum (Austria)

Acta Physiol. Pol.
Acta Physiologica Polonica (Poland)

Acta Physiol. Scand.
Acta Physiologica Scandinavica (Sweden)

Acta Phys. Pol., A
Acta Physica Polonica, A (Poland)

Acta Phys. Pol., B
Acta Physica Polonica, B (Poland)

Acta Pol. Pharm.
Acta Poloniae Pharmaceutica (Poland)

Acta Polytech. (Prague), IV
Acta Polytechnica (Prague), (Rada) IV. Technicko-Tecreticka (Czechoslovakia)

Acta Radiol., Diagn.
Acta Radiologica, Diagnosis (Sweden)

Acta Radiol., Ther., Phys., Biol.
Acta Radiologica, Therapy, Physics, Biology (Sweden)

Acta Rheum. Scand.
Acta Rheumatologica Scandinavica (Sweden)

Acta Soc. Med. Upsal.
Acta Societatis Medicorum Upsaliensis (Sweden)

Acta Stomatol. Belg.
Acta Stomatologica Belgica (Belgium)

Acta Tech. CSAV
Acta Technica CSAV (Ceskoslovenska Akademia Ved) (Czechoslovakia)

Acta Univ. Carolinae, Med.
Acta Universitatis Carolinae, Medica (Czechoslovakia)

Acta Univ. Wratislaviensis
Acta Universitatis Wratislaviensis (Poland)

Acta Vet. (Brno)
Acta Veterinaria (Brno) (Czechoslovakia)

Acta Vet. Acad. Sci. Hung.
Acta Veterinaria Academiae Scientiarum Hungaricae (Hungary)

Acta Vet. Scand., Suppl.
Acta Veterinaria Scandinavica, Supplementum (Denmark)

Adhes. Age
Adhesives Age (U.S.)

ADM (Asoc. Dent. Mex.) Rev.
ADM (Asociacion Dental Mexicana) Revista (Mexico)

Advan. Astronaut. Sci.
Advances in Astronautical Sciences (U.S.)

Advan. At. Mol. Phys.
Advances in Atomic and Molecular Physics (U.S.)

Advan. Chem. Ser.
Advances in Chemistry Series (U.S.)

Advan. Cryog. Eng.
Advances in Cryogenic Engineering (U.S.)

Advan. High Temp. Chem.
Advances in High Temperature Chemistry (U.S.)

Advan. Hum. Genet.
Advances in Human Genetics (U. S.)

Advan. Inorg. Chem. Radiochem.
Advances in Inorganic Chemistry and Radiochemistry (U.S.-England)

Advan. Nucl. Phys.
Advances in Nuclear Physics (U. S.)

Advan. Phys.
Advances in Physics (England)

Advan. Radiat. Chem.
Advances in Radiation Chemistry (U. S.)

Advan. Space Sci. Technol.
Advances in Space Science and Technology (U.S.)

Advan. X-Ray Anal.
Advances in X-Ray Analysis (U.S.)

Aeronaut. Astronaut. (Paris)
Aeronautique et l'Astronautique (Formerly Technique et Science Aeronautiques et Spatiales) (France)

Aerosp. Med.
Aerospace Medicine (Formerly The Journal of Aviation Medicine) (U. S.)

Aerztl. Forsch.
Aerztliche Forschung (West Germany)

AGARD Conf. Proc.
AGARD Conference Proceedings (France)

Agr. Biol. Chem. (Tokyo)
Agricultural and Biological Chemistry (Tokyo) (Japan)

Agrochimica
Agrochimica (Italy)

Agrokhimiya
Agrokhimiya (U.S.S.R.)

AIAA (Amer. Inst. Aeronaut. Astronaut.) J.
AIAA (American Institute of Aeronautics and Astronautics) Journal (Combining the ARS Journal and the Journal of Aerospace Science) (U.S.)

Akush. Ginekol.
Akusherstvo i Ginekologiya (U.S.S.R.)

Ala. J. Med. Sci.
Alabama Journal of Medical Sciences, The (U.S.)

Aliment. Vie
Alimentation et la Vie (Formerly Bulletin de la Societe Scientifique d'Hygiene Alimentaire et d'Alimentation Rationnelle) (France)

Alta Freq.
Alta Frequenza. Rivista di Radiotecnica, Telefonia e Acustica Applicata (Italy)

AMDEL (Aust. Miner. Develop. Lab.) Bull.
AMDEL (Australian Mineral Development Laboratories) Bulletin (Australia)

Amer. Ass. Advan. Sci., Symp.
American Association for the Advancement of Science, Symposium (U.S.)

Amer. Ceram. Soc. Bull.
American Ceramic Society Bulletin, The (U.S.)

Amer. Fam. Physician - GP
American Family Physician - GP (U. S.)
Supersedes GP, Journal of the American Academy of General Practice
Changed to American Family Physician

Amer. Heart J.
American Heart Journal (U.S.)

Amer. Ind. Hyg. Ass. J.
American Industrial Hygiene Association Journal (U.S.)

Amer. J. Anat.
American Journal of Anatomy, The (U.S.)

Amer. J. Clin. Pathol.
American Journal of Clinical Pathology (U.S.)

Amer. J. Epidemicl.
American Journal of Epidemiology (U.S.)

Amer. J. Int. Law
American Journal of International Law (U.S.)

Amer. J. Obstet. Gynecol.
American Journal of Obstetrics and Gynecology (U.S.)

Amer. J. Ophthalmol.
American Journal of Ophthalmology (U.S.)

Amer. J. Optom.
American Journal of Optometry (U.S.)

Amer. J. Pathol.
American Journal of Pathology, The (U.S.)

Amer. J. Phys.
American Journal of Physics (U.S.)

Amer. J. Physiol.
American Journal of Physiology, The (U.S.)

Amer. J. Pub. Health
American Journal of Public Health (U.S.)

Amer. J. Roentgenol., Radium Ther. Nucl. Med.
American Journal of Reontgenology, Radius Therapy and Nuclear Medicine, The (U.S.)

Amer. J. Surg.
American Journal of Surgery, The (U.S.)

Amer. J. Vet. Res.
American Journal of Veterinary Research (U.S.)

Amer. Lect. Ser.
American Lecture Series (U. S.)

Amer. Midland Natur.
American Midland Naturalist (U.S.)

Amer. Mineral.
American Mineralogist, The (U.S.)

Amer. Rev. Respirat. Dis.
American Review of Respiratory Diseases (U.S.)

Amer. Sci.
American Scientist (U.S.)

Amer. Soc. Test. Mater., Spec. Tech. Publ.
American Society for Testing and Materials, Special Technical Publication (U. S.)

An. Acad. Brasil. Cienc.
Anais da Academia Brasileira de Ciencias (Brazil)

Anal. Biochem.
Analytical Biochemistry (U.S.)

Anal. Chem.
Analytical Chemistry (U.S.)

Anal. Chim. Acta
Analytica Chimica Acta (Netherlands)

Anal. Lett.
Analytical Letters (U.S.)

Analyst
Analyst, The (England)

Angew. Bot.
Angewandte Botanik (West Germany)

Angew. Chem. Int. Ed. Engl.
Angewandte Chemie. International Edition in English (U.S.-West Germany)

Angew. Makromol. Chem.
Angewandte Makromolekulare Chemie (Switzerland)

Ann. Acad. Sci. Fenn., Ser. A IV
Annales Academiae Scientiarum Fennicae, Series A IV. Biologia (Finland)

Ann. Acad. Sci. Fenn., Ser. A VI
Annales Acadamiae Scientiarum Fennicae, Series A VI. Physica (Finland)

Ann. Agr. Fenn., Ser. Agrogeol., -Chim. -Phys.
Annales Agriculturae Fenniae, Seria Agrogeologia, -Chimica et -Physica (Finland)

Ann. Amelior. Plant.
Annales de l'Amelioration des Plantes (Formerly Annales de l'Institut Naticnal de la Recherche Agronomique, Serie B) (France)

Ann. Chim. (Paris)
Annales de Chimie (Paris) (France)

Ann. Chim. (Rome)
Annali di Chimica (Rome) (Italy)

Ann. Clin. Res., Suppl.
Annals of Clinical Research, Supplement (Finland)

Ann. Endocrinol. (Paris)
Annales d'Endocrinologie (Paris) (France)

Ann. Entomol. Soc. Amer.
Annals of the Entomological Society of America (U.S.)

Ann. Genet. (Paris)
Annales de Genetique (Paris) (France)

Ann. Geophys.
Annales de Geophysique (France)

Ann. Inst. Henri Poincare, Sect. A
Annales de l'Institut Henri Poincare, Section A. Physique Theorique (France)

Ann. Inst. Pasteur, Paris
Annales de l'Institut Pasteur, Paris (France)

Ann. Inst. Tech. Batiment Trav. Publics
Annales de l'Institut Technique du Batiment et des Travaux Publics (France)

Ann. Ist. Super. Sanita
Annali dell' Istituto Superiore di Sanita (Italy)

Ann. Limnol.
Annales de Limnologie (France)

Ann. Med. Exp. Biol. Fenn. (Helsinki)
Annales Medicinae Experimentalis et Biologiae Fenniae (Helsinki) (Finland)

Ann. Med. Interne
Annales de Medecine Interne (France)
Supersedes Bull. Mem. Soc. Med. Hop. Paris

Ann. Med. Nav.
Annali di Medicina Navale (Italy)

Ann. Mines
Annales des Mines (France)

Ann. N.Y. Acad. Sci.
Annals of the New York Academy of Sciences (U.S.)

Ann. Occup. Hyg.
Annals of Occupational Hygiene, The (England)

Ann. Ocul. (Paris)
Annales d'Oculistique (Paris) (France)

Annot. Zool. Jap.
Annotationes Zoologicae Japonenses (Japan)

Ann. Phys. (Leipzig)
Annalen der Physik (Leipzig) (East Germany)

Ann. Phys. (N.Y.)
Annals of Physics (New York) (U.S.)

Ann. Phys. (Paris)
Annales de Physique (Paris) (France)

Ann. Phys. Biol. Med.
Annales de Physique Biologique et Medicale (France)

Ann. Radiol.
Annales de Radiologie (France)

Ann. Sanita Pubblica
Annali della Sanita Pubblica (Italy)

Ann. Scu. Norm. Super. Pisa, Sci. Fis. Mat.
Annali della Scuola Normale Superiore di Pisa, Scienze Fisiche e Matematiche (Italy)

Ann. Soc. Sci. Brux. Ser. I
Annales de la Societe Scientifique de Bruxelles. Serie I (Belgium)

Ann. Soc. Geol. Belg.
Annales de la Societe Geologique de Belgique (Belgium)

Ann. Surg.
Annals of Surgery (U.S.)

Ann. Telecommun.
Annales des Telecommunications (France)

Ann. Univ. Turk., Ser. A1
Annales Universitatis Turkuensis, Series A1, Astronomica-Chemica-Physica-Mathematica (continues in part Annales Universitatis Turkuensis, Series A) (Finland)

Annu. Rep. Res. Inst. Environ. Med., Nagoya Univ.
Annual Report of the Research Institute of Environmental Medicine, Nagoya University (Japan)

Annu. Rep. Res. Reactor Inst., Kyoto Univ.
Annual Reports of the Research Reactor Institute, Kyoto University (Japan)

Annu. Rev. Astron. Astrophys.
Annual Review of Astronomy and Astrophysics (U.S.)

Annu. Rev. Fluid Mech.
Annual Review of Fluid Mechanics (U. S.)

Annu. Rev. Med.
Annual Review of Medicine (U.S.)

Annu. Rev. Nucl. Sci.
Annual Review of Nuclear Science (U.S.)

Annu. Rev. Plant Physiol.
Annual Review of Plant Physiology (U.S.)

Ann. Zool.-Ecol. Anim.
Annales de Zoologie-Ecologie Animale (France)

Ann. Zool. Fenn.
Annales Zoologici Fennici (Finland)

An. Real Acad. Nac. Med. (Madrid)
Anales de la Real Academia Nacional de Medicina (Madrid) (Spain)

An. Stiint. Univ. Al. I. Cuza Iasi, Sect. Ib. Fiz.
Analele Stiintifice ale Universitatii Al. I. Cuza din Iasi, Sectiunea Ib. Fizica (Romania)

Antarct. J. U. S.
Antarctic Journal of the United States (U.S.)

Antibiotiki
Antibiotiki (U.S.S.R.)

Antonie Van Leeuwenhoek J. Microbiol. Serol.
Antonie Van Leeuwenhoek Journal of Microbiology and Serology (Netherlands)

An. Univ. Bucuresti, Ser. Stiint. Natur., Fiz.
Analele Universitatii Bucuresti, Seria Stiintele Naturii, Fizica (Romania)

Appl. Microbiol.
Applied Microbiology (U.S.)

Appl. Opt.
Applied Optics (U.S.)

Appl. Phys. Lett.
Applied Physics Letters (U.S.)

Appl. Polym. Symp.
Applied Polymer Symposia (supersedes in part Journal of Applied Polymer Science) (U. S.)

Appl. Sci. Res. (The Hague)
Applied Scientific Research (The Hague) (Netherlands)

Appl. Spectrosc.
Applied Spectroscopy (U.S.)

Arbeitsmed. - Sozialmed. - Arbeitshyg.
Arbeitsmedizin - Sozialmedizin - Arbeitshygiene (West Germany)

Archaeometry
Archaeometry (England)

Arch. Biochem. Biophys.
Archives of Biochemistry and Biophysics (U.S.)

Arch. Biol. (Liege)
Archives de Biologie (Liege) (Belgium)

Arch. Dermatol.
Archives of Dermatology (U.S.)

Arch. De Vecchi Anat. Patol. Med. Clin.
Archivio De Vecchi Anatomia Patological e la Medicina Clinic (Italy)

Arch. Eisenhuettenw.
Archiv fuer das Eisenhuettenwesen (West Germany)

Arch. Elektrotech. (Warsaw)
Archiwum Elektrotechniki (Warsaw) (Poland)

Arch. Entwicklungsmech. Organ.
Archiv fuer Entwicklungsmechanik der Organismen, Wilhelm Roux (West Germany)

Arch. Environ. Health
Archives of Environmental Health (Formerly A.M.A. Archives of Industrial Health) (U.S.)

Arch. Fac. Med. Zaragoza
Archivos de la Facultad de Medicina de Zaragoza (Spain)

Arch. Fisiol.
Archivio di Fisiologia (Italy)

Arch. Gesam. Virusforsch.
Archiv fuer die Gesamte Virusforschung (Austria)

Arch. Geschwulstforsch.
Archiv fuer Geschwulstforschung (East Germany)

Arch. Hyg. Bakteriol.
Archiv fuer Hygiene und Bakteriologie (West Germany)

Arch. Immunol. Ther. Exp.
Archivum Immunologiae et Therapiae Experimentalis (Poland)

Arch. Ital. Patol. Clin. Tumori
Archivo Italiano di Patoligia e Clinica dei Tumori (Italy)

Arch. Klin. Exp. Dermatol.
Archiv fuer Klinische und Experimentelle Dermatologie (West Germany)
Changed to Arch. Dermatol. Forsch.

Arch. Klin. Exp. Ohren-, Nasen- Kehlkopfheilk.
Archiv fuer Klinische und Experimentelle Ohren-, Nasen- und Kehlkopfheilkunde (West Germany)

Arch. Klin. Exp. Ophthalmol.
Archiv fuer Klinische und Experimentelle Ophthalmologie (West Germany)

Arch. Lebensmittelhyg.
Archiv fuer Lebensmittelhygiene Insbesondere fuer Fleisch, Fisch, und Milchhygiene (West Germany)

Arch. Mal. Coeur Vaiss.
Archives des Maladies du Coeur et des Vaisseaux (France)

Arch. Mal. Prof. Med. Trav. Secur. Sociale
Archives des Maladies Professionnelles de Medicine du Travail et de Securite Sociale (France)

Arch. Mech. Stosow.
Archiwum Mechaniki Stosowanej (Poland)

Arch. Mikrobiol.
Archiv fuer Mikrobiologie (West Germany)

Arch. Ophtalmol.
Archives d'Ophtalmologie (France)

Arch. Ophthalmol. (Chicago)
Archives of Ophthalmology (Chicago) (U. S.)

Arch. Oral Biol.
Archives of Oral Biology (England)

Arch. Otolaryngol.
Archives of Otolaryngology (U.S.)

Arch. Pathol.
Archives of Pathology (Formerly A.M.A. Archives of Pathology) (U.S.)

Arch. Pharmakol. Exp. Pathol.
Archiv fuer Pharmakologie und Experimentelle Pathologie (Formerly Archiv fuer Experimentelle Pathologie und Pharmakologie, Naunyn-Schmiedebergs) (West Germany) Superseded by Naunyn-Schmiedebergs Arch. Pharmakol.

Arch. Phys. Ther. (Leipzig)
Archiv fuer Physikalische Therapie, Balneologie und Klimatologie (Leipzig) (East Germany)

Arch. Ration. Mech. Anal.
Archive for Rational Mechanics and Analysis (West Germany)

Arch. Roum. Pathol. Exp. Microbiol.
Archives Roumaines de Pathologie Experimentale et de Microbiologie (France)

Arch. Surg. (Chicago)
Archives of Surgery (Chicago) (U. S.)

Arch. Toxikol.
Archiv fuer Toxikologie (West Germany)

Arch. Vecchi Anat. Patol. Med. Clin.
Archivio de Vecchi per l'Anatomia Patologica e la Medicina Clinica (Italy)

Arch. Vet. Ital.
Archivio Veterinario Italiano (Italy)

Arh. Hig. Rada Toksikol.
Arhiv za Higijenu Rada i Toksikologiju (Yugoslavia)

Ark. Fys.
Arkiv for Fysik, Utgivet av Kungliga Svenska Vetenskapsakademien (Sweden)
Superseded by Physica Scripta

Ark. Fys. Seminar Trondheim
Arkiv for det Fysiske Seminar i Trondheim (Norway)

Arkh. Anat., Gistol. Embriol.
Arkhiv Anatomii, Gistologii i Embriologii (U.S.S.R.)

Arkhimedes
Arkhimedes (Finland)

Arkh. Patol.
Arkhiv Patologii (U.S.S.R.)

Ark. Kem.
Arkiv for Kemi, Utgivet av Kungliga Svenska Vetenskapakademien (Sweden)
Superseded by Chemica Scripta

Arm. Khim. Zh.
Armyanskii Khimicheskii Zhurnal (Formerly Izvestiya Akademii Nauk Armyanskoi SSR, Khimicheskie Nauk) (Armenian S.S.R.)

Arq. Patol. (Lisbon)
Arquivos de Patologia (Lisbon) (Portugal)

Arzneim.-Forsch.
Arzneimittel-Forschung. Drug Research (West Germany)

Ass. Geofis. Ital., Atti Conv. Annu.
Associazione Geofisica Italiana, Atti del Convegno Annuale (Italy)

ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.
ASTM (American Society for Testing and Materials) Special Technical Publication (U.S.)

Astron. Astrophys.
Astronomy and Astrophysics (Formed by the Merging of Annales d'Astrophysique, Bulletin of the Astronomical Institutes of the Netherlands, Bulletin Astronomique, Journal des Observateurs, and Zeitschrift fuer Astrophysik) (West Germany - U.S.)

Astron. Astrophys., Suppl. Ser.
Astronomy and Astrophysics, Supplement Series (Netherlands)

Astronaut. Aeronaut.
Astronautics and Aeronautics (Formerly Astronautics and Aerospace Engineering) (U.S.)

Astron. J.
Astronomical Journal, The (U.S.)

Astron. Nachr.
Astronomische Nachrichten (East Germany)

Astrophysics (Engl. Transl.)
Astrophysics (English Translation of Astrofizika) (U.S.)

Astrophys. J.
Astrophysical Journal, The (U.S.)

Astrophys. J., Suppl. Ser.
Astrophysical Journal, The, Supplement Series (U.S.)

Astrophys. Lett.
Astrophysical Letters (Scotland)

Astrophys. Space Sci.
Astrophysics and Space Science (Netherlands)

At. Energ. (USSR)
Atomnaya Energiya (U.S.S.R.)
Issued in English Translation as Soviet Journal of Atomic Energy, The

At. Energy Aust.
Atomic Energy in Australia (Australia)

At. Energy Law Rep.
Atomic Energy Law Reports (U. S.)

At. Energy Rev.
Atomic Energy Review (Austria)

Atmos. Environ.
Atmospheric Environment (England)

Atom (London)
Atom (London) (England)

Atomkernenergie
Atomkernenergie (Formerly Atomenergie) (West Germany)

ATOMKI (At. Kut. Intez.) Kozlem.
ATOMKI (Atomag Kutato Intezet) Kozlemenyek (Hungary)

Atompraxis
Atompraxis (West Germany)
Incorporated in Kerntechnik; published from Jan. 1971 as Kerntechnik Incorporating Atompraxis

Atomtech. Tajek.
Atomtechnikai Tajekoztato (Hungary)
Changed to Izotoptechnika

Atomu
Atomu (Atom (Tokyo)) (Japan)

Atomwirt., Atomtech.
Atomwirtschaft, Atomtechnik
(Formerly Atomwirtschaft, Die) (West Germany)

Atoomenergie Haar Toepass.
Atoomenergie en Haar Toepassingen (Formerly RCN Bulletin) (Netherlands)

At. Strom
Atom und Strom (West Germany)

Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.
Atti della Accademia Nazionale dei Lincei, Rendiconti, Classe di Scienze Fisiche, Matematiche e Naturali (Italy)

Atti Accad. Sci. Lett. Palermo
Atti dell Accademia di Scienze Lettere e Arti di Palermo (Italy)

Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.
Atti della Accademia delle Scienze di Torino. (Part) I. Classe di Scienze Fisiche, Matematiche e Naturali (Italy)

Atti Soc. Ital. Cardiol.
Atti della Societa Italiana di Cardiologia (Italy)

Aust. Chem. Process. Eng.
Australian Chemical Processing and Engineering (Australia)

Aust. J. Agr. Res.
Australian Journal of Agricultural Research (Australia)

Aust. J. Biol. Sci.
Australian Journal of Biological Sciences (Australia)

Aust. J. Chem.
Australian Journal of Chemistry (Australia)

Aust. J. Exp. Biol. Med. Sci.
Australian Journal of Experimental Biology and Medical Science, The (Australia)

Aust. J. Med. Technol.
Australian Journal of Medical Technology (Australia)

Aust. J. Phys.
Australian Journal of Physics (Australia)

Aust. J. Phys., Astrophys. Suppl.
Australian Journal of Physics, Astrophysical Supplement (Australia)

Aust. Mining
Australian Mining (Australia)

Aust. N. Z. J. Obstet. Gynaecol.
Australian and New Zealand Journal of Obstetrics and Gynaecology (Australia)

Aust. N. Z. J. Surg.
Australian and New Zealand Journal of Surgery (Australia)

Australas. Ann. Med.
Australasian Annals of Medicine (Australia)
Superseded by Australian and New Zealand Journal of Medicine

Australas. Bull. Med. Phys. Biophys.
Australasian Bulletin of Medical Physics and Biophysics (Australia)

Australas. Corros. Eng.
Australasian Corrosion Engineering (Australia)

Australas. Eng.
Australasian Engineer (Australia)

Australas. Inst. Mining Met. Proc.
Australasian Institute of Mining and Metallurgy Proceedings (Australia)

Australas. J. Pharm.
Australasian Journal of Pharmacy (Australia)

Australas. Radiol.
Australasian Radiology (Formerly Journal of the College of Radiologists of Australasia) (Australia)

Aust. Transp.
Australian Transport (Australia)

Automatisme
Automatisme (France)

Avian Dis.
Avian Diseases (U.S.)

Avtomat. Svarka
Avtomaticheskaya Svarka (Ukrainian S.S.R.)
Issued in English Translation as Automatic Welding (USSR)

Azerb. Khim. Zh.
Azerbaidzhanskii Khimicheskii Zhurnal (Azerbaidzhan S.S.R.)

Azerb. Med. Zh.
Azerbaidzhanskii Meditsinskii Zhurnal (Azerbaidzhan S.S.R.)

B

BBC-Nachr.
BBC-Nachrichten (Switzerland)

Beitr. Pathol.
Beitraege zur Pathologie (West Germany)
Supersedes Beitraege zur Pathologischen Anatomie und zur Allgemeinen Pathologie

Beitr. Pathol. Anat. Allg. Pathol.
Beitraege zur Pathologischen Anatomie und zur Allgemeinen Pathologie (West Germany)
Superseded by Beitraege zur Pathologie

Beitr. Plasmaphys.
Beitraege aus der Plasmaphysik (East Germany)

Beitr. Radioastron.
Beitraege zur Radiostronomie (West Germany)

Ber. Bunsenges. Phys. Chem.
Berichte der Bunsengesellschaft fuer Physikalische Chemie (Formerly Zeitschrift fuer Elektrochemie) (West Germany)

Ber. Deut. Keram. Ges.
Berichte der Deutschen Keramischen Gesellschaft E. V. (West Germany)

Berlin. Muenchen. Tieraerztl. Wochenschr.
Berliner und Muenchener Tieraerztliche Wochenschrift (West Germany)

Beton Zhelezobeton
Beton i Zhelezobeton (Georgian S.S.R.)

Bibl. Anat.
Bibliotheca Anatomica (Switzerland)

Biochem. Biophys. Res. Commun.
Biochemical and Biophysical Research Communications (U.S.)

Biochem. Genet.
Biochemical Genetics (U.S.)

Biochemistry
Biochemistry (U.S.)

Biochem. J.
Biochemical Journal (England)

Biochem. Soc. Symp.
Biochemical Society Symposia (England)

Biochim. Biophys. Acta
Biochimica et Biophysica Acta (Netherlands)

Biofizika
Biofizika (U.S.S.R.)
For English Translation see Biophysics (USSR)

Biokhimiya
Biokhimiya (U.S.S.R.)
For English Translation see Biochemistry (USSR) (U.S.)

Biol. Bull.
Biological Bulletin, The (U.S.)

Biol. Gastro-Enterol.
Biologie et Gastro-Enterologie (Supplement to Archives Francaise des Maladies de l'Appareil Digestif) (France)

Biol. Listy
Biologicke Listy (Czechoslovakia)

Biol. Nauki
Biologicheskie Nauki (U.S.S.R.)

Biologia (Bratislava)
Biologia (Bratislava) (Czechoslovakia)

Biol. Plant. (Prague)
Biologia Plantarum (Prague) (Czechoslovakia)

Biol. Zh. Arm.
Biologicheskii Zhurnal Armenii (Formerly Izvestiya Akademii Nauk Armyanskoi SSR, Biologicheskie Nauki) (Armenian S.S.R.)

Bio-Med. Eng.
Bio-Medical Engineering (England)

Biomed. Sci. Instrum.
Biomedical Sciences Instrumentation (U.S.)

Bionika
Bionika (Ukrainian S.S.R.)

Biophysics (USSR) (Engl. Transl.)
Biophysics (USSR) (English Translation of Biofizika) (England)

Biophysik
Biophysik (West Germany)

Biophys. J.
Biophysical Journal (U.S.)

Bioscience
Bioscience (U.S.)

Blech
Blech (West Germany)

Blood
Blood. The Journal of Hematology (U.S.)

Blut
Blut. Zeitschrift fuer Gesamte Blutforschung (West Germany)

Boei Daigakko Rikogaku Kenkyu Hokoku
Boei Daigakko Rikogaku Kenkyu Hokoku (Scientific and Engineering Reports of the Defense Academy) (Japan)

Bol. Estud. Med. Biol.
Boletin de Estudios Medicos y Biologicos (Mexico)

Boll. Soc. Ital. Biol. Sper.
Bollettino della Societa Italiana di Biologia Sperimentale (Italy)

Boll. Soc. Ital. Fis.
Bollettino della Societa Italiana di Fisica (Italy)

Borgyogy. Venerol. Szemle
Borgyogyaszati es Venerologiai Szemle (Hungary)

Boshoku Gijutsu
Boshoku Gijutsu (Corrosion Engineering) (Japan)

Bot. Zh.
Botanicheskii Zhurnal (U.S.S.R.)

Bratislav. Lek. Listy
Bratislavske Lekarske Listy (Czechoslovakia)

Brennst.-Waerme-Kraft
Brennstoff-Waerme-Kraft (West Germany)

Brit. Corros. J.
British Corrosion Journal (England)

Brit. J. Cancer
British Journal of Cancer (England)

Brit. J. Dermatol.
British Journal of Dermatology (England)

Brit. J. Haematol.
British Journal of Haematology (England)

Brit. J. Non-Destruct. Test.
British Journal of Non-Destructive Testing (England)

Brit. J. Occup. Saf.
British Journal of Occupational Safety (England)

Brit. J. Radiol.
British Journal of Radiology (England)

Brit. Med. J.
British Medical Journal, The (England)

Brit. Vet. J.
British Veterinary Journal, The (England)

Brot Gebaeck
Brot und Gebaeck (West Germany)

Bul. Inst. Politeh. Brasov, Ser. B
Buletinul Institutului Politehnic din Brasov, Seria B. Economie Forestiera (Romania)

Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucuresti
Buletinul Institutului Politehnic Gheorghe Gheorghiu-Dej Bucuresti (Romania)

Bull. Acad. Pol. Sci., Ser. Sci. Biol.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Biologiques (Poland)

Bull. Acad. Pol. Sci., Ser. Sci. Chim.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Chimiques (Poland)

Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences, Mathematiques, Astronomiques et Physiques (Poland)

Bull. Acad. Pol. Sci., Ser. Sci. Tech.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Techniques (Poland)

Bull. Acad. Sci. USSR, Phys. Ser. (Engl. Transl.)
Bulletin of the Academy of Sciences of the USSR, Physical Series (English Translation of Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya) (U.S.)

Bull. Astron. Inst. Czech.
Bulletin of the Astronomical Institutes of Czechoslovakia (Czechoslovakia)

Bull. At. Sci.
Bulletin of the Atomic Scientists (U.S.)

Bull. Aust. Math. Soc.
Bulletin of the Australian Mathematical Society (Australia)

Bull. Biol. Fr. Belg.
Bulletin Biologique de la France et de la Belgique (France)

Bull. Boris Kidric Inst. Nucl. Sci., Chem.
Bulletin of the Boris Kidric Institute of Nuclear Sciences, Chemistry (Yugoslavia)

Bull. Boris Kidric Inst. Nucl. Sci., Nucl. Eng.
Bulletin of the Boris Kidric Institute of Nuclear Sciences, Nuclear Engineering (Yugoslavia)

Bull. Boris Kidric Inst. Nucl. Sci., Phys.
Bulletin of the Boris Kidric Institute of Nuclear Sciences, Physics (Yugoslavia)

Bull. Calcutta Math. Soc.
Bulletin of the Calcutta Mathematical Society (India)

Bull. Calcutta Sch. Trop. Med.
Bulletin of the Calcutta School of Tropical Medicine (India)

Bull. Chem. Soc. Jap.
Bulletin of the Chemical Society of Japan (Japan)

Bull. Cl. Sci., Acad. Roy. Belg.
Bulletin de la Classe des Sciences, Academie Royale de Belgique (Belgium)

Bull. EGU
Bulletin EGU (Vyzkumny Ustav Energeticky) (Czechoslovakia)

Bull. Eidgenoess. Gesundh., Beil. B
Bulletin des Eidgenoessisches Gesundheitsamtes, Beilage B (Switzerland)

Bull. Environ. Contam. Toxicol.
Bulletin of Environmental Contamination and Toxicology (U.S.-West Germany)

Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.)
Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire) (France)

Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.
Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire), Supplement (France)

Bull. Inform. Bur. Nat. Metrol.
Bulletin d'Information du Bureau National de Metrologie (France)

Bull. Inform. Sci. Tech. (Paris)
Bulletin d'Information Scientifique et Technique (Paris) (France)

Bull. Inst. Chem. Res., Kyoto Univ.
Bulletin of the Institute for Chemical Research, Kyoto University (Japan)

Bull. Inst. Int. Froid, Annexe
Bulletin de l'Institut International du Froid, Annexe (France)

Bull. Kyushu Inst. Technol., Math., Natur. Sci.
Bulletin of the Kyushu Inst. of Technology, Mathematics, Natural Science (Japan)

Bull. Los Angeles Neurol. Soc.
Bulletin of the Los Angeles Neurological Society (U.S.)

Bull. Math. Biophys.
Bulletin of Mathematical Biophysics (U.S.)

Bull. Seismol. Soc. Amer.
Bulletin of the Seismological Society of America (U.S.)

Bull. Soc. Belge Ophthalmol.
Bulletin de la Societe Belge d'Ophthalmologie (Belgium)

Bull. Soc. Bot. Fr.
Bulletin de la Societe Botanique de France (France)

Bull. Soc. Chim. Belg.
Bulletin des Societes Chimiques Belges (Belgium)

Bull. Soc. Chim. Fr.
Bulletin de la Societe Chimique de France (France)

Bull. Soc. Fr. Ceram.
Bulletin de la Societe Francaise de Ceramique (France)

Bull. Soc. Fr. Miner. Cryst.
Bulletin de la Societe Francaise de Mineralogie et de Cristallographie (France)

Bull. Soc. Int. Chir.
Bulletin de la Societe Internationale de Chirurgie(Belgium)

Bull. Soc. Roy. Bot. Belg.
Bulletin de la Societe Royale de Botanique de Belgique (Belgium)

Bull. Soc. Roy. Sci. Liege
Bulletin de la Societe Royale des Sciences de Liege (Belgium)

Bull. Tokyo Gakugei Univ., Ser. 4
Bulletin of the Tokyo Gakugei University, Series 4 (Japan)

Bull. Tokyo Inst. Technol. (Engl. Ed.)
Bulletin of the Tokyo Institute of Technology (English Edition) (Not the same publication as Tokyo Kogyo Daigaku Gakuho) (Japan)

Bull. Tokyo Med. Dent. Univ.
Bulletin of Tokyo Medical and Dental University (Japan)

Bull. World Health Organ.
Bulletin of the World Health Organization (U.S.)

Bul. Stiint. Univ. Craiova
Buletinul Stiintific al Universitatii Craiova (Romania)

Bundesgesundheitsblatt
Bundesgesundheitsblatt (West Germany)

Bunko Kenkyu
Bunko Kenkyu (Journal of the Spectroscopical Society of Japan) (Japan)

Bunseki Kiki
Bunseki Kiki (Analytical Instruments) (Japan)

Butsuri Tanko
Butsuri Tanko (Geophysical Exploration) (Japan)

Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR
Byulleten, Abastumanskaya Astrofizicheskaya Observatoriya, Akademiya Nauk Gruzinskoi SSR (Georgian S.S.R.)

Byull. Eksp. Biol. Med.
Byulleten Eksperimental'noi Biologii i Meditsiny (U.S.S.R.) For English Translation see Bulletin of Experimental Biology and Medicine (USSR)

C

Cah. Ing. Agron.
Cahiers des Ingenieurs Agronomes (France)

Cah. Oceanogr.
Cahiers Oceanographiques (France)

Calcified Tissue Res.
Calcified Tissue Research (West Germany)

Calif. Agr.
California Agriculture (U. S.)

Californium-252 Progr.
Californium-252 Progress (U. S.)

Cancer
Cancer (U.S.)

Cancer Chemother. Rep.
Cancer Chemotherapy Reports (U.S.)

Cancer Res.
Cancer Research (U.S.)

Can. Contr. Instrum.
Canadian Controls and Instrumentation (Canada)

Cancro
Cancro, Il (Italy)

Can. Entomol.
Canadian Entomologist, The (Canada)

Can. Inst. Food Technol. J.
Canadian Institute of Food Technology Journal (Canada)

Can. J. Anim. Sci.
Canadian Journal of Animal Science (Canada)

Can. J. Biochem.
Canadian Journal of Biochemistry (Supersedes in Part Canadian Journal of Biochemistry and Physiology) (Canada)

Can. J. Bot.
Canadian Journal of Botany (Canada)

Can. J. Chem.
Canadian Journal of Chemistry (Canada)

Can. J. Chem. Eng.
Canadian Journal of Chemical Engineering (Formerly Canadian Journal of Technology) (Canada)

Can. J. Earth Sci.
Canadian Journal of Earth Sciences (Canada)

Can. J. Genet. Cytol.
Canadian Journal of Genetics and Cytology (Canada)

Can. J. Microbiol.
Canadian Journal of Microbiology (Canada)

Can. J. Phys.
Canadian Journal of Physics (Canada)

Can. J. Physiol. Pharmacol.
Canadian Journal of Physiology and Pharmacology (Supersedes in Part Canadian Journal of Biochemistry and Physiology) (Canada)

Can. J. Plant Sci.
Canadian Journal of Plant Science (Canada)

Can. J. Public Health
Canadian Journal of Public Health (Canada)

Can. J. Soil Sci.
Canadian Journal of Soil Science (Canada)

Can. J. Zool.
Canadian Journal of Zoology (Canada)

Can. Med. Ass. J.
Canadian Medical Association Journal, The (Canada)

Can. Met. Quart.
Canadian Metallurgical Quarterly (Canada)

Can. Mining J.
Canadian Mining Journal (Incorporates Mining in Canada) (Canada)

Can. Res. Develop.
Canadian Research and Development (Formerly Canadian Nuclear Technology) (Canada)

Can. Spectrosc.
Canadian Spectroscopy (Canada)

Carbohyd. Res.
Carbohydrate Research (Netherlands)

Carbon
Carbon (England)

Cardiol. Prat.
Cardiologia Pratica (Italy)

Caryologia
Caryologia (Italy)

Cas. Lek. Cesk.
Casopis Lekaru Ceskych (Czechoslovakia)

Celestial Mech.
Celestial Mechanics (Netherlands)

Cell Tissue Kinet.
Cell and Tissue Kinetics (England)

Cereal Chem.
Cereal Chemistry (U.S.)

CERN Cour.
CERN Courier (Switzerland)

Cesk. Cas. Fys.
Ceskoslovensky Casopis pro Fysiku (Czechoslovakia)

Cesk. Farm.
Ceskoslovenska Farmacie (Czechoslovakia)

Cesk. Fysiol.
Ceskoslovenska Fysiologie (Czechoslovakia)

Cesk. Gastroenterol. Vyz.
Ceskoslovenska Gastroenterologie a Vyziva, Sbornik pro Pathofysiolcgii Traveni a Vyzivy (Czechoslovakia)

Cesk. Hyg.
Ceskoslovenska Hygiena (Czechoslovakia)

Cesk. Otolaryngol.
Ceskoslovenska Otolaryngologie (Czechoslovakia)

Cesk. Pediat.
Ceskoslovenska Pediatrie (Czechoslovakia)

Cesk. Radiol.
Ceskoslovenska Radiologie (Formerly Ceskoslovenska Rentgenologie) (Czechoslovakia)

Cesk. Stomatol.
Ceskoslovenska Stomatologie (Czechoslovakia)

Cesk. Zdrav.
Ceskoslovenske Zdravotnictvi (Czechoslovakia)

Chem. Anal. (Warsaw)
Chemia Analityczna (Warsaw) (Poland)

Chem. Ber.
Chemische Berichte (West Germany)

Chem. Can.
Chemistry in Canada (Canada)

Chem. Eng. Prcgr.
Chemical Engineering Progress (U.S.)

Chem. Eng. Prcgr., Symp. Ser.
Chemical Engineering Progress, Symposium Series (U.S.)

Chem. Eng. Sci.
Chemical Engineering Science (England)

Chem. Gecl.
Chemical Geology (Netherlands)

Chem. Ind. (Lcndcn)
Chemistry and Industry (London) (England)

Chem.-Ing.-Tech.
Chemie-Ingenieur-Technik (West Germany)

Chem. Instrum.
Chemical Instrumentation (U.S.)

Chem. Labor Betr.
Chemie fuer Labcr und Betrieb (West Germany)

Chem. Listy
Chemicke Listy (Czechoslovakia)

Chem. Pharm. Bull. (Tokyo)
Chemical and Pharmaceutical Bulletin (Tokyo) (Japan)

Chem. Phys. Lett.
Chemical Physics Letters (Netherlands)

Chem. Process Eng.
Chemical and Prccess Engineering (England)

Chem. Ztg.
Chemiker Zeitung (West Germany)

Chem. Zvesti
Chemicke Zvesti (Czechoslovakia)

Chest (Chicago)
Chest (Chicago) (U. S.)
Supersedes Diseases of the Chest

Chiba Igakkai Zasshi
Chiba Igakkai Zasshi (The Journal of Chiba Medical Society) (Japan)

Chim. Anal. (Paris)
Chimie Analytique (Paris) (France)

Chimia (Aarau)
Chimia (Aarau) (Switzerland)

Chim. Ind. (Milan)
Chimica e l'Industria, La (Milan) (Italy)

Chim. Ind., Genie Chim.
Chimie et Industrie, Genie Chimique (Formed by the Merger of Chimie et Industrie (Paris) and Genie Chimique (Paris)) (France)

Chin. J. Phys. (Taiwan)
Chinese Journal of Physics (Taiwan) (China)

Chishitsugaku Zasshi
Chishitsugaku Zasshi (Journal of the Geological Society of Japan) (Japan)

Chitaniumu Jirukoniumu
Chitaniumu Jirukoniumu (Titanium, Zirconium) (Japan)

Cho-Kccn Kenkyu
Cho-Koon Kenkyu (Japan)

Chromatcgr. Rev.
Chromatographic Reviews (Netherlands)

Chromcscma
Chromosoma (West Germany)

Chubu Denryoku K. K. Kenkyu Shiryo
Chubu Denrycku K. K. Kenkyu Shiryo (Memoirs of the Chubu Electric Power Co., Ltd.) (Japan)

Chubu Nippon Seikei Geka Saigai Geka Gakkai Zasshi
Chubu Nippon Seikei Geka Saigai Geka Gakkai Zasshi (The Central Japan Journal of Orthopaedic and Traumatic Surgery) (Japan)

Chutanzo
Chutanzo (Casting and Forging) (Japan)

CIM (Can. Mining Met.) Bull.
CIM (Canadian Mining and Metallurgy) Bulletin (Formerly Canadian Mining and Metallurgy Bulletin) (Canada)

Civil Def. Bull.
Civil Defence Bulletin (Australia)

Civil Eng. (N. Y.)
Civil Engineering (New York) (U.S.)

Clin. Chem.
Clinical Chemistry (U.S.)

Clin. Chim. Acta
Clinica Chimica Acta (Netherlands)

Clin. Exp. Immunol.
Clinical and Experimental Immunology (England)

Clin. Orthop.
Clinical Orthopaedics (U.S.)
Superseded by Clinical Orthopaedics and Related Research

Clin. Radiol.
Clinical Radiology (Scotland)

Clin. Sci.
Clinical Science (England)

Clin. Ter.
Clinica Terapeutica (Italy)

Cobalt
Cobalt (Belgium)

Collect. Czech. Chem. Commun.
Collection of Czechoslovak Chemical Communications (Czechoslovakia)

Colloq. Met., Commis. Energ. At. (Fr.)
Colloque de Metallurgie, Commissariat a l Energie Atomique (France)

Colo. Sch. Mines, Miner. Ind. Bull.
Colorado Schcol of Mines, Mineral Industries Bulletin (U.S.)

Combust. Flame
Combustion and Flame (U.S.)

Combustion
Combustion (U.S.)

Combust. Sci. Technol.
Combustion Science and Technology (U. S.-England)

Commentat. Phys.-Math.
Commentationes Physico-Mathematicae (Finland)

Comments Astrcphys. Space Phys.
Comments on Astrophysics and Space Physics (England - U. S.)

Comments At. Mol. Phys.
Comments on Atomic and Molecular Physics (England - U. S.)

Comments Earth Sci., Geophys.
Comments on Earth Sciences, Geophysics (England)

Comments Nucl. Particle Phys.
Comments on Nuclear and Particle Physics (England - U. S.)

Comments Solid State Phys.
Comments on Solid State Physics (England - U. S.)

Commun. Math. Phys.
Communicaticns in Mathematical Physics (West Germany)

Com. Naz. Energ. Nucl., Notiz.
Comitato Nazionale per l'Energia Nucleare, Notiziario (Italy)

Comp. Biochem. Physiol.
Comparative Biochemistry and Physiology (England) Divided into parts A and B

Composits
Composits (England)

Compt. Rend., Ser. A, B
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Series A, et B (France

Compt. Rend., Ser. C
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Serie C (France)

Compt. Rend., Ser. D
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Serie D (France)

Compt. Rend. Acad. Bulg. Sci.
Comptes Rendus de l'Academie Bulgare des Sciences (Bulgaria)

Compt. Rend. Hebd. Seances Acad. Agr. Fr.
Comptes Rendus Hebdomadaires des Seances de l'Academie d'Agriculture de France (France)

Compt. Rend. Soc. Biol.
Comptes Rendus des Seances de la Societe de Biologie et de ses Filiales (France)

Comput. Biol. Med.
Computers in Biology and Medicine (U.S.)

Comput. Biomed. Res.
Computers and Biomedical Research (U.S.)

Comput. Phys. Commun.
Computer Physics Communications (Netherlands)

Constr. Masini
Constructia de Masini (Romania)

Contemp. Phys.
Contemporary Physics (England)

Corrosion
Corrosion (U.S.)

Corros. Sci.
Corrosion Science (England)

Corros.-Trait., Prot., Finition
Corrosion-Traitements, Protection, Finition (Formerly Corrosion et Anti-Corrosion) (France)

Cosmic Electrodyn.
Cosmic Electrodynamics (Netherlands)

Cosmic Res. (USSR) (Engl. Transl.)
Cosmic Research (USSR) (English Translation of Kosmicheskie Issledovaniya) (U.S.)

Cost Eng.
Cost Engineering (U.S.)

CRC Crit. Rev. Anal. Chem.
CRC Critical Reviews in Analytical Chemistry (U. S.)

CRC Crit. Rev. Clin. Lab. Sci.
CRC Critical Reviews in Clinical Laboratory Sciences (U. S.)

CRC Crit. Rev. Environ. Contr.
CRC Critical Reviews in Environmental Control (U. S.)

CRC Crit. Rev. Radiol. Sci.
CRC Critical Reviews in Radiological Sciences (U. S.)

CRC Crit. Rev. Solid State Sci.
CRC Critical Reviews in Solid State Sciences (U. S.)

Croat. Chem. Acta
Croatica Chemica Acta (Yugoslavia)

Crop Sci.
Crop Science (U.S.)

Cryobiology
Cryobiology (U. S.)

Cryogenics
Cryogenics (England)

Cryog. Ind. Gases
Cryogenic and Industrial Gases (formerly Cryogenic Engineering News) (U.S.)

Cryst. Lattice Defects
Crystal Lattice Defects (Northern Ireland)

Curr. Mod. Biol.
Currents in Modern Biology (Netherlands)

Curr. Notes Int. Aff.
Current Notes on International Affairs (Australia)

Curr. Sci. (India)
Current Science (India)

Curr. Top. Microbiol. Immunol.
Current Topics in Microbiology and Immunology (Formerly Ergebnisse der Mikrobiologie und Immunitaetsforschung und Experimentellen Therapie) (West Germany)

Cytobios
Cytobios (England)

Czas. Stomatol.
Czasopismo Stomatologiczne (Poland)

Czech. J. Phys.
Czechoslovak Journal of Physics (Czechoslovakia)

D

Daehan Hwahak Hwoejee
Daehan Hwahak Hwoejee (Journal of the Korean Chemical Society) (South Korea)

Deep-Sea Res. Oceanogr. Abstr.
Deep-Sea Research and Oceanographic Abstracts (Formerly Deep-Sea Research) (England)

Defektoskopiya
Defektoskopiya (U.S.S.R.)
Issued in English translation as Soviet Journal of Nondestructive Testing

Def. Sci. J. (New Delhi)
Defence Science Journal (New Delhi) (India)

Denki Gakkai Zasshi
Denki Gakkai Zasshi (The Journal of the Institute of Electrical Engineers of Japan) (Japan)

Denki Hyoron
Denki Hyoron (Electrical Review) (Japan)

Denki Kagaku
Denki Kagaku (Journal of the Electrochemical Society of Japan) (Japan)

Denki Shikensho Iho
Denki Shikensho Iho (Bulletin of the Electrotechnical Laboratory (Tokyo)) (Japan)

Denpa Kenkyusho Kiho
Denpa Kenkyusho Kiho (Review of the Radio Research Laboratory) (Japan)

Denryoku Shinpo
Denryoku Shinpo (Japan)

Denshi Gijutsu Sogo Kenkyusho Iho
Denshi Gijutsu Sogo Kenkyusho Iho (Japan)

Denshi Tsushin Gakkai Ronbunshi, C
Denshi Tsushin Gakkai Ronbunshi, C (Japan)

Dent. Surv.
Dental Survey (U.S.)

Des. Eng. (London)
Design Engineering, Materials and Components (London) (England)

Deut. Gesundheitsw.
Deutsche Gesundheitswesen, Das (West Germany)

Deut. Gewaesserk. Mitt.
Deutsche Gewaesserkundliche Mitteilungen (West Germany)

Deut. Med. Wochenschr.
Deutsche Medizinische Wochenschrift. (West Germany)
Issued in English language edition as German Medical Monthly

Deut. Stomatol.
Deutsche Stomatologie (East Germany)

Deut. Zahnaertztl. Z.
Deutsche Zahnaerztliche Zeitschrift (East Germany)

Deut. Zahn-, Mund- Kieferheilk.
Deutsche Zahn-, Mund- und Kieferheilkunde mit Zentralblatt fuer die Gesamte Zahn-, Mund- und Kieferheilkunde (East Germany)

Deut. Z. Nervenheilk.
Deutsche Zeitschrift fuer Nervenheilkunde (West Germany)
Superseded by Z. Neurol.

Develop. Appl. Spectrosc.
Developments in Applied Spectroscopy (U. S.)

Develop. Biol.
Developmental Biology (U.S.)

Differential Equations (Engl. Transl.)
Differential Equations (English Translation of Differentsial'nye Uravneniya) (U.S.)

Diffus. Data
Diffusion Data (U.S.)

Dis. Colon Rectum
Diseases of the Colon and Rectum (U.S.)

Diss. Pharm. Pharmacol.
Dissertationes Pharmaceuticae et Pharmacologicae (Poland)
Supersedes Diss. Pharm.

DMIC Rev.
DMIC Review of Recent Developments (U.S.)

Doboku Gakkaishi
Doboku Gakkaishi (Journal of the Japan Society of Civil Engineers) (Japan)

Dobutsugaku Zasshi
Dobutsugaku Zasshi (Zoological Magazine) (Japan)

Doc. Haematol. (Bucharest)
Documenta Haematologica (Bucharest) (Romania)

Doc. Ophthalmol.
Documenta Ophthalmologica (Advances in Ophthalmology) (Netherlands)

Dokl. Akad. Nauk Arm. SSR
Doklady Akademii Nauk Armyanskoi SSR (Armenian S.S.R.)

Dokl. Akad. Nauk Azerb. SSR
Doklady Akademii Nauk Azerbaidzhanskoi SSR (Azerbaidzhan S.S.R.)

Dokl. Akad. Nauk BSSR
Doklady Akademii Nauk BSSR (Belorussian S.S.R.)

Dokl. Akad. Nauk SSSR
Doklady Akademii Nauk SSSR (U.S.S.R.)
Issued in English Translation by Sections

Dokl. Akad. Nauk Tadzh. SSR
Doklady Akademii Nauk Tadzhikskoi SSR (Tadzhik S.S.R.)

Dokl. Akad. Nauk Uzb. SSR
Doklady Akademii Nauk Uzbekskoi SSR (Uzbek S.S.R.)

Dopov. Akad. Nauk Ukr. RSR, Ser. A
Dopovidi Akademii Nauk Ukrains'koi RSR, Seriya A Fiziko-Tekhnichni ta Matematichni Nauki (Supersedes in Part Dopovidi Akademii Nauk Ukrains'koi RSR) (Ukrainian S.S.R.)

Dopov. Akad. Nauk Ukr. RSR, Ser. B
Dopovidi Akademii Nauk Ukrains'koi RSR, Seriya B Geologiia, Geofizika, Khimiya na Biologiya (Supersedes In Part Dopovidi Akademii Nauk Ukrains'koi RSR) (Ukrainian S.S.R.)

Dorycku
Doryoku (Nippon Doryoku Kyokai Kaiho) (Power (Journal of the Japan Power Association)) (Japan)

Drevc
Drevo (Czechoslovakia)

Duodecim
Duodecim (Finland)

E

Earth Extraterr. Sci.
Earth and Extraterrestrial Sciences (England)

Earth Planet. Sci. Lett.
Earth and Planetary Science Letters (Netherlands)

Earth Sci. Bull.
Earth Science Bulletin (U.S.)

East. Metals Rev.
Eastern Metals Review (India)

Eclogae Geol. Helv.
Eclogae Geologicae Helvetiae (Switzerland)

Ecology
Ecology (U.S.)

Econ. Geol.
Economic Geology and the Bulletin of the Society of Economic Geologists (U.S.)

Economist (London)
Economist (London), The (England)

Effluent Water Treat. J.
Effluent and Water Treatment Journal (England)

Eisei Kagaku
Eisei Kagaku (The Journal of Hygienic Chemistry) (Japan)

Eisei Shikenjo Hokoku
Eisei Shikenjo Hokoku (Bulletin of National Institute of Hygenic Sciences) (Japan)

Ekol. Pol., Ser. B
Ekologia Polska, Seria B. Referaty, Dyskusje
Supersedes in Part Ekologia Polska

Eksp. Khir. Anesteziol.
Eksperimentalnaya Khirurgia i Anesteziologiya (U.S.S.R.)

ELDO/ESRO Sci. Tech. Rev.
ELDO/ESRO Scientific and Technical Review (France)

Elec.-Electron. Mod.
Electricite-Electronique Moderne (France)

Elec. Eng. (Sydney)
Electrical Engineer (Sydney) (Australia)

Elec. Eng. Jap. (Engl. Transl.)
Electrical Engineering in Japan (English Translation of Denki Gakkai Zasshi) (U.S.)

Elec. Light Power (Boston)
Electric Light and Power (Boston) (U.S.)

Elec. Times
Electrical Times (England)

Electrochim. Acta
Electrochimica Acta (England)

Electrochim. Metal.
Electrochimica Metallorum (Italy)

Electromedica
Electromedica (West Germany)

Electromyography
Electromyography (Belgium)

Electron. Eng.
Electronic Engineering (Formerly Electronic Engineering Incorporating Electronics, Television and Short Wave World) (England)

Electron. Lett.
Electronics Letters (England)

Electron. World
Electronics World (U.S.)

Elec. World
Electrical World (U.S.)

Elektrichestvo
Elektrichestvo (U.S.S.R.)

Elektrizitaetswirtschaft
Elektrizitaetswirtschaft (West Germany)

Elektrokhimiya
Elektrokhimiya (U.S.S.R.)

Elektronika
Elektronika (Formerly Przeglad Elektroniki) (Poland)

Elektron. Obrab. Mater.
Elektronnaya Obrabotka Materialov (Moldavian S.S.R.)

Elektrotech. Cas.
Elektrotechnicky Casopis (Czechoslovakia)

Elektrotech. Maschinenbau
Elektrotechnik und Maschinenbau (Austria)

Elektrotech. Z., A
Elektrotechnische Zeitschrift, A (West Germany)

Elektrotech. Z., B
Elektrotechnische Zeitschrift, B (West Germany)

Elektrotehnika (Zagreb)
Elektrotehnika (Zagreb) (Yugoslavia)

Elektrotekhnika
Elektrotekhnika (U.S.S.R.)

Elelmez. Ipar
Elelmezesi Ipar (Hungary)

Emen
Emen. Journal of the University of Manchester Metallurgical Society (England)

Endocrinol. Exp.
Endocrinologia Experimentalis (Czechoslovakia)

Endocrinology
Endocrinology (U.S.)

Energetika
Energetika (Czechoslovakia)

Energie
Energie (West Germany)

Energ. Nucl. (Madrid)
Energia Nuclear (Madrid) (Spain)

Energ. Nucl. (Milan)
Energia Nucleare (Milan) (Italy)

Energ. Nucl. (Paris)
Energie Nucleaire (Paris) (France)

Energ. Stroit.
Energeticheskoe Stroitel'stvo (U.S.S.R.)

Energ. Tech.
Energie und Technik (West Germany)

Energy Convers.
Energy Conversion (Formerly Advanced Energy Conversion) (England)

Eng. Fracture Mech.
Engineering Fracture Mechanics (England)

Engineer
Engineer, The (England)

Engineering
Engineering (England)

Eng. J. (Montreal)
Engineering Journal, The (Montreal) (Canada)

Eng. Mining J.
Engineering and Mining Journal (U.S.)

Entropie
Entropie (France)

Environ. Res.
Environmental Research (U.S.)

Environ. Sci. Technol.
Environmental Science and Technology (U. S.)

Enzymologia
Enzymologia (Netherlands)

Epitoanyag
Epitoanyag (Hungary)

Erdoel Kohle, Erdgas, Petrochem.
Erdoel und Kohle, Erdgas, Petrochemie (West Germany)

Ergeb. Exakten Naturwiss.
Ergebnisse der Exakten Naturwissenschaften (West Germany) Changed to Springer Tracts in Modern Physics (Ergebnisse der Exakten Naturwissenschaften) with Vol. 38

Erzmetall
Erzmetall (West Germany)
Supersedes Z. Erzbergbau Metallhuettenw.

Essays Phys.
Essays in Physics (England)

Euphytica
Euphytica. Netherlands Journal of Plant Breeding (Netherlands)

Eur. J. Biochem.
European Journal of Biochemistry (Formerly Biochemische Zeitschrift) (West Germany)

Eur. J. Cancer
European Journal of Cancer (England)

Euro-Spectra
Euro-Spectra. Scientifical and Technical Review of the European Communities (Formerly Euratom Review) (Belgium)

Eur. Polym. J.
European Polymer Journal (England)

Exp. Cell Res.
Experimental Cell Research (U.S.)

Experientia
Experientia (Switzerland)

Exp. Eye Res.
Experimental Eye Research (England)

Exp. Gerontol.
Experimental Gerontology (England)

Exp. Hematol.
Experimental Hematology (U.S.)

Exp. Mech.
Experimental Mechanics (U.S.)

Exp. Neurol.
Experimental Neurology (U.S.)

Exp. Parasitol.
Experimental Parasitology (U.S.)

Exp. Tech. Phys.
Experimentelle Technik der Physik (East Germany)

F

FAPIG (Tokyo)
FAPIG (Tokyo) (Japan)

Farbe Lack
Farbe und Lack (West Germany)

Farmakol. Toksikol.
Farmakologiya i Toksikologiya (U.S.S.R.)
Issued In English Translation as Pharmacology and Toxicology (USSR)

Farmatsiya (Moscow)
Farmatsiya (Moscow) (Formerly Aptechnoe Delo) (U.S.S.R.)

Farm. Obz.
Farmaceuticky Obzor (Czechoslovakia)

Farm. Zh.
Farmatsevtychnyi Zhurnal (Ukrainian S.S.R.)

Farumashia
Farumashia (Pharmacy) (Japan)

Fert. Steril.
Fertility and Sterility (U.S.)

Fette-Seifen-Anstrichm.
Fette-Seifen-Anstrichmittel (Combined with Ernaehrungsindustrie) (West Germany)

Fields Quanta
Fields and Quanta (England)

Fizika (Zagreb)
Fizika (Zagreb) (Yugoslavia)

Fiziol. Biokhim. Kul't. Rast.
Fiziolcgiya i Biokhimiya Kul'turnykh Rastenii (Ukrainian S. S. R.)

Fiziol. Norm. Patol. (Bucharest)
Fiziologia Normala si Patologica (Bucharest) (Romania)

Fiziol. Rast.
Fiziologiya Rastenii (U.S.S.R.)
Issued in English translation as Sov. Plant. Physiol.

Fiziol. Zh., Akad. Nauk Ukr. RSR
Fiziologichnii Zhurnal, Akademiya Nauk Ukrainskoi RSR (Ukrainian S.S.R.)

Fiz.-Khim. Mekh. Mater.
Fiziko-Khimicheskaya Mekhanika Materialov (Ukrainian S.S.R.)
Issued in English translation as Soviet Materials Science

Fiz. Khim. Obrab. Mater.
Fizika i Khimiya Obrabotki Materialov (U.S.S.R.)

Fiz. Metal. Metalloved.
Fizika Metallov i Metallovedeniya, Akademiya Nauk SSSR, Ural'skii Filial (U.S.S.R.)
For English Translation see The Physics of Metals and Metallography (USSR)

Fiz. Szemle
Fizikai Szemle (Hungary)

Fiz. Tekh. Poluprov.
Fizika i Tekhnika Poluprovodnikov (U.S.S.R.)
Issued in English Translation as Soviet Physics-Semiconductors

FOA (Forsvarets Forsk.) Rep.
FOA (Forsvarets Forskningsanstalt) Reports (Sweden)

Folia Biol. (Krakow)
Folia Biologica (Krakow) (Poland)

Folia Biol. (Prague)
Folia Biologica (Prague) (Czechoslovakia)

Folia Clin. Int.
Folia Clinica Internacional (Spain)

Folia Haematol. (Leipzig)
Folia Haematologia (Leipzig) (East Germany)

Folia Med. Cracov.
Folia Medica Cracoviensia (Poland)

Folia Med. (Naples)
Folia Medica (Naples) (Italy)

Folia Med. (Plovdiv)
Folia Medica (Plovdiv) (Bulgaria)

Folia Med. Fac. Med. Univ. Saraeviensis
Folia Medica Facultatis Medicinae Universitatis Saraeviensis (Yugoslavia)

Folia Microbiol. (Prague)
Folia Microbiologica (Prague) (Czechoslovakia)

Fonderia Ital.
Fonderia Italiana (Italy)

Food Cosmet. Toxicol.
Food and Cosmetics Toxicology (England)

Food Ind. J.
Food Industries Journal (India)

Food Irradiat.
Food Irradiation (France)

Food Technol.
Food Technology (U.S.)

Food Technol. Aust.
Food Technology in Australia (Australia)

Forsch. Ingenieurw.
Forschung im Ingenieurwesen (West Germany)

Fortschr. Geb. Roentgenstr. Nuklearmed.
Fortschritte auf dem Gebiete der Roentgenstrahlen und der Nuklearmedizin (West Germany)

Fortschr. Kiefer- Gesichtschir.
Fortschritte der Kiefer- und Gesichtschirurgie (West Germany)

Fortschr. Med.
Fortschritte der Medizin (West Germany)

Fortschr. Phys.
Fortschritte der Physik (East Germany)

Found. Phys.
Foundations of Physics (U.S.)

Fracastoro
Fracastoro (Italy)

Freiberg. Forschungsh., B
Freiberger Forschungshefte, Reihe B (East Germany)

Fuel
Fuel. A Journal of Fuel Science (England)

Fuji Jiho
Fuji Jiho (The Fuji Electric Journal) (Japan)

Fukui Daigaku Kogakubu Kenkyu Hokoku
Fukui Daigaku Kogakubu Kenkyu Hokoku (Memoirs of the Faculty of Engineering, Fukui University) (Japan)

Fukuoka Igaku Zasshi
Fukuoka Igaku Zasshi (Fukuoka Acta Medica) (Japan)

Fukushima Igaku Zasshi
Fukushima Igaku Zasshi (Fukushima Medical Journal) (Japan)

Fune No Kagaku
Fune No Kagaku (Marine Engineering) (Japan)

Funtai Kogaku
Funtai Kogaku (Powder Engineering) (Japan)

Funtai Oyobi Funmatsuyakin
Funtai Oyobi Funmatsuyakin (Journal of the Japan Society of Powder and Powder Metallurgy) (Japan)

Fysiat. Reumatol. Vestn.
Fysiatricky a Reumatologicky Vestnik (Formerly Fysiatricky Vestnik) (Czechoslovakia)

Fys. Tidsskr.
Fysisk Tidsskrift (Denmark)

Fyz. Cas.
Fyzikalny Casopis, Vydavatel'stvo Slovenskej Akademie Vied (Czechoslovakia)

G

Gamma Field Symp.
Gamma Field Symposia, Ibaraki (Japan)

Ganka
Ganka (Ophthalmology) (Japan)

Gann
Gann (Japan)

GANN Monogr.
GANN Monograph (Japan)

Gan No Rinsho
Gan No Rinsho (Japanese Journal of Cancer Clinics) (Japan)

Ganseki Kobutsu Kosho Gakkaishi
Ganseki Kobutsu Kosho Gakkaishi (The Journal of the Japanese Association of Mineralogists, Petrologists and Economic Geologists) (Japan)

Gastroenterologia
Gastroenterologia International Review of Gastroenterology (Switzerland)
Superseded by Digestion

Gastroenterology
Gastroenterology (U.S.)

Gas- Wasserfach, Wasser - Abwasser
Gas- und Wasserfach, Wasser - Abwasser (West Germany)
Continues in part Gas- und Wasserfach, Das

Gaz, Woda Tech. Sanit.
Gaz, Woda i Technika Sanitarna (Poland)

Gazz. Chim. Ital.
Gazzetta Chimica Italiana (Italy)

G. Batteriol., Virol., Immunol. Ann. Osp
Maria Vittoria Torino

Giornale di Batteriologia, Virologia, ed Immunologia ed Annali dell'Ospedale Maria Vittoria di Torino (Italy)

Geburtsh. Frauenheilk.
Geburtshilfe und Frauenheilkunde (West Germany)

Gegenbaurs Morphol. Jahrb.
Gegenbaurs Morphologisches Jahrbuch (East Germany)

Genen Phaenen
Genen en Phaenen (Netherlands)

Genet. Agr.
Genetica Agraria (Italy)

Genetica
Genetica (Netherlands)

Genetics
Genetics (U.S.)

Genetika
Genetika (U.S.S.R.)
Issued in English Translation as Soviet Genetics

Genet. Selek.
Genetika i Selektsiya (Bulgaria)

Genet. Slechteni
Genetika a Slechteni (Czechoslovakia)

Gen. Relativity Gravitation
General Relativity and Gravitation (England)

Genshiryoku Hakusho
Genshiryoku Hakusho (Japan)

Genshiryoku Iinkai Geppo
Genshiryoku Iinkai Geppo (Journal of Atomic Energy Commission) (Japan)

Genshiryoku Kogyo
Genshiryoku Kogyo (Nuclear Engineering) (Japan)

Genshiryokusen
Genshiryokusen (Nuclear Ships) (Japan)

Geochem. Int. (Engl. Transl.)
Geochemistry International (English Translation of Selected Articles from Geokhimiya Together with Selected Translated Geochemical Papers from Other Languages) (U.S.)

Geochim. Cosmochim. Acta
Geochimica et Cosmochimica Acta (England)

Geofiz. App.
Geofizicheskaya Apparatura (U.S.S.R.)

Geofiz. Byull.
Geofizicheskii Byulleten (U.S.S.R.)

Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.
Geofizicheskii Sbornik, Akademiya Nauk Ukrainskoi SSR, Institut Geofiziki (Ukrainian S.S.R.)

Geokhimiya
Geokhimiya (U.S.S.R.)
Selected Articles Appear in English Translation in Geochemistry International

Geol. Geofiz.
Geologiya i Geofizika (U.S.S.R.)

Geol. Pruzkum
Geologicky Pruzkum (Czechoslovakia)

Geol. Rud. Mestorozhd.
Geologiya Rudnykh Mestorozhdenii, Akademiya Nauk SSSR (U.S.S.R.)

Geol. Zh. (Russ. Ed.)
Geologicheskii Zhurnal (Russian Edition) (Ukrainian S.S.R.)

Geomagn. Aeron. (USSR) (Engl. Transl.)
Geomagnetism and Aeronomy (USSR) (English Translation of Geomagnetizm i Aeronomiya) (U.S.)

Geophysica
Geophysica (Finland)

Geophys. J. Roy. Astron. Soc.
Geophysical Journal of The Royal Astronomical Society (England)

Geriatrics
Geriatrics (U.S.)

Gerlands Beitr. Geophys.
Gerlands Beitraege zur Geophysik (Formerly carried as Beitraege zur Geophysik, Gerlands) (East Germany)

Getreide Mehl
Getreide und Mehl (West Germany)

G. Gerontol.
Giornale di Gerontologia (Italy)

Gidrobiol. Zh.
Gidrobiologicheskii Zhurnal (Ukrainian S.S.R.)

G. Ig. Med. Prev.
Giornale di Igiene e Medicina Preventiva (Italy)

Gig. Sanit.
Gigiena i Sanitariya (U.S.S.R.)
Issued in English Translation as Hygiene and Sanitation (USSR)

Gig. Tr. Prof. Zabol.
Gigiena Truda i Professional'nye Zabolevaniya (U.S.S.R.)

Ginekol. Pol.
Ginekologia Polska (Poland)

G. Ital. Dermatol.
Giornale Italiano di Dermatologia (Italy)

G-I-T (Glas- Instrum.-Tech.) Fachz. Lab.
G-I-T (Glas- und Instrumenten-Technik) Fachzietschrift fuer das Laboratorium (West Germany)

Glueckauf
Glueckauf (West Germany)

Gradbeni Vestn.
Gradbeni Vestnik (Yugoslavia)

Growth
Growth (U.S.)

Guy's Hosp. Rep.
Guy's Hospital Reports (England)

Gynaecologia
Gynaecologia (Switzerland)
Changed to Gynecologic Investigation

H

Haematol. Lat. (Milan)
Haematologica Latina (Milan) (Italy)

Haematologica (Pavia)
Haematologica (Pavia) (Italy)

Haikan Gijutsu
Haikan Gijutsu (The Piping Engineering) (Japan)

Haikan To Sochi
Haikan To Sochi (Piping and Process Machinery) (Japan)

Hakko Kyokaishi
Hakko Kyokaishi (Journal of The Fermentation Association of Japan) (Japan)

Handelsblatt
Handelsblatt (West Germany)

Harefuah
Harefuah (Israel)

Health Lab. Sci.
Health Laboratory Science (U.S.)

Health Phys.
Health Physics (England)

Heat Transfer - Sov. Res.
Heat Transfer - Soviet Research (U.S.)

Heizung-Lueftung-Haustech.
Heizung-Lueftung-Haustechnik (West Germany)

Helgolaender Wiss. Meeresunters.
Helgolaender Wissenschaftliche Meeresuntersuchungen (West Germany)

Helv. Chim. Acta
Helvetica Chimica Acta (Switzerland)

Helv. Chir. Acta
Helvetica Chirurgica Acta (Switzerland)

Helv. Phys. Acta
Helvetica Physica Acta (Switzerland)

Hereditas
Hereditas (Sweden)

Heredity
Heredity. An International Journal of Genetics (England)

High Energy Chem. (USSR) (Engl. Transl.)
High Energy Chemistry (USSR) (English Translation of Khimiya Vysokikh Energiya) (U. S.)

High Temp. (USSR) (Engl. Transl.)
High Temperature (USSR) (English Translation of Teplofizika Vysokikh Temperatur) (U. S.)

High Temp. - High Pressures
High Temperatures - High Pressures. International Journal of Research (England)

High Temp. Sci.
High Temperature Science. An International Journal (U.S.)

Hihakai Kensa
Hihakai Kensa (Journal of NDI) (Japan)

Hinyokika Kiyo
Hinyokika Kiyo (Acta Urological Japonica) (Japan)

Hippokrates (Stuttgart)
Hippokrates (Stuttgart) (West Germany)

Hirosaki Daigaku Nogakubu Gakujutsu Hokoku
Hirosaki Daigaku Nogakubu Gakujutsu Hokoku (Bulletin of the Faculty of Agriculture, Hirosaki University) (Japan)

Hiroshima Igaku
Hiroshima Igaku (Journal of the Hiroshima Medical Association) (Japan)

Hiroshima J. Med. Sci.
Hiroshima Journal of Medical Sciences (Japan)

Histochemie
Histochemie (West Germany)

Hitachi Hyoron
Hitachi Hyoron (The Hitachi Review) (Japan)

HNO
HNO, Wegweiser fuer die Fachaerztliche Praxis (West Germany)

Hoken Butsuri
Hoken Butsuri (Journal of Japan Health Physics Society) (Japan)

Hokkaido Kyoiku Daigaku Kiyo, Dai-2-Bu, C
Hokkaido Kyoiku Daigaku Kiyo, Dai-2-Bu, C, Katei, Taiiku-hen (Journal of Hokkaido Univ. of Education, Section 2, C, Domestic Science, Physical Education) (Japan)

Hokkaidoritsu Eisei Kenkyushoho
Hokkaidoritsu Eisei Kenkyushoho (Report of the Hokkaido Inst. of Public Health) (Japan)

Holzforschung
Holzforschung (West Germany)

Honvedorvos
Honvedorvos (Hungary)

Horm. Metab. Res.
Hormone and Metabolic Research (West Germany)

Hoshasen Kagaku
Hoshasen Kagaku (Japan)

Hospital (Rio de Janeiro)
Hospital (Rio de Janeiro) (Brazil)

Houille Blanche
Houille Blanche, La (France)

Houston Geol. Soc. Bull.
Houston Geological Society Bulletin (U.S.)

Hua Hsueh
Hua Hsueh (Chemistry (Taipei)) (China (Taiwan))
Ceased Publication

Hung. Sci. Instrum.
Hungarian Scientific Instruments (Hungary)

Hutn. Listy
Hutnicke Listy (Czechoslovakia)

I

Icarus
Icarus. International Journal of the Solar System (U.S. - England)

Iden
Iden (Heredity) (Japan)

Idojaras
Idojaras (Hungary)

IEEE (Inst. Elec. Electron. Eng.), Spectrum
IEEE (Institute of Electrical and Electronics Engineers), Spectrum (U.S.)

IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Antennas and Propagation (U.S.)

IEEE (Inst. Elec. Electron. Eng.), Trans. Broadcast Telev. Receivers
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Broadcast and Television Receivers (U. S.)

IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Magnetics (U.S.)

IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers), Transactions on Nuclear Science) (U.S.)

Igaku Kenkyu
Igaku Kenkyu (Acta Medica) (Fukouka) (Japan)

Igiena (Bucharest)
Igiena (Bucharest) (Romania)

Ig. Mod.
Igiene Moderna (Italy)

Ig. Sanita Pubblica
Igiene e Sanita Pubblica (Italy)

Immunology
Immunology (England)

Ind. Aliment. (Pinerolo, Italy)
Industrie Alimentari (Pinerolo, Italy) (Italy)

Ind. Aliment. Agr. (Paris)
Industries Alimentaires et Agricoles (Paris) (France)

Ind. At.
Industries Atomiques (France)

Ind. Chim. Belge
Industrie Chimique Belge (Belgium)

Ind. Conserve
Industria Conserve (Italy)

Ind. Eng. Chem., Prod. Res. Develop.
Industrial and Engineering Chemistry, Product Research and Development (U.S.)

Ind. Heat.
Industrial Heating (U.S.)

Indian East. Eng.
Indian and Eastern Engineer, the (Incorporating the Far Eastern Engineer and Indian and Eastern Motors) (India)

Indian J. Agr. Sci.
Indian Journal of Agricultural Science, The (India)

Indian J. Appl. Chem.
Indian Journal of Applied Chemistry (India)

Indian J. Biochem.
Indian Journal of Biochemistry (India)

Indian J. Cancer
Indian Journal of Cancer (India)

Indian J. Chem.
Indian Journal of Chemistry (India)

Indian J. Exp. Biol.
Indian Journal of Experimental Biology (India)

Indian J. Genet. Plant Breed.
Indian Journal of Genetics and Plant Breeding (India)

Indian J. Hort.
Indian Journal of Horticulture (India)

Indian J. Math.
Indian Journal of Mathematics (Indian)

Indian J. Meteorol. Geophys.
Indian Journal of Meteorology and Geophysics (India)

Indian J. Phys.
Indian Journal of Physics and Proceedings of The Indian Association for the Cultivation of Science (India)

Indian J. Power River Valley Develop.
Indian Journal of Power and River Valley Development (India)

Indian J. Pure Appl. Math.
Indian Journal of Pure and Applied Mathematics (India)

Indian J. Pure Appl. Phys.
Indian Journal of Pure and Applied Physics (India)

Indian J. Sci. Ind.
Indian Journal of Science and Industry (India)
Divided into Sections A and B

Indian J. Sci. Ind., Sect. A
Indian Journal of Science and Industry, Section A. Agricultural Sciences (India)
Continues in part Indian Journal of Science and Industry

Indian J. Technol.
Indian Journal of Technology (Formerly Journal of Scientific and Industrial Research (India), Section D) (India)

Indian J. Theor. Phys.
Indian Journal of Theoretical Physics (India)

Ind. Lab. (USSR) (Engl. Transl.)
Industrial Laboratory (USSR) (English Translation of Zavodskaya Laboratoriya) (U.S.)

Ind. Med. Surg.
Industrial Medicine and Surgery (U.S.)

Ind. Obst- Gemueseverwert.
Industrielle Obst- und Gemueseverwertung (West Germany)

Ind. Process Heat.
Industrial and Process Heating (England)

Ind. Res.
Industrial Research (U.S.)

Industriekurier
Industriekurier (West Germany)

Infec. Immunity
Infection and Immunity (U. S.)

Inform. Bull. Isotop. Generators
Information Bulletin on Isotopic Generators (France)
Supersedes Newsletter of the Isotopic Generator Information Centre

Inform. Byull. Sov. Antarkt. Eksped.
Informatsionnyi Byulleten Sovetskoi Antarkticheskoi Ekspeditsii (U.S.S.R.)

Infrared Phys.
Infrared Physics. An International Research Journal (England)

Ingenieursblad
Ingenieursblad (Belgium)

Ingenieur (Utrecht)
Ingenieur, De (Utrecht) (Netherlands)

Ing. Nucl.
Ingegneria Nucleare (Italy)

Inorg. Chem.
Inorganic Chemistry (U.S.)

Inorg. Mater. (USSR) (Engl. Transl.)
Inorganic Materials (USSR) (English Translation of Izvestiya Akademii Nauk SSSR, Neorganicheskie Materialy) (U.S.)

Inorg. Nucl. Chem. Lett.
Inorganic and Nuclear Chemistry Letters (England-U.S.)

Instrum. Exp. Tech. (USSR) (Engl. Transl.)
Instruments and Experimental Techniques (USSR) (English Translation of Pribory i Tekhnika Eksperimenta) (U.S.)

Instrum. Pract.
Instrument Practice. Control Systems, Electronics, Automation (England)

Int. Arch. Allergy Appl. Immunol.
International Archives of Allergy and Applied Immunology (Switzerland)

Int. At. Energy Agency Bull.
International Atomic Energy Agency Bulletin (Austria)

Int. Chem. Eng.
International Chemical Engineering. A Quarterly Journal of Translations from Russia, Eastern Europe, and Asia (U.S.)

Interceram (Luebeck, Ger.)
Interceram (Luebeck, Germany) (West Germany)

Int. J. Appl. Radiat. Isotop.
International Journal of Applied Radiation and Isotopes (England)

Int. J. Cancer
International Journal of Cancer (Denmark)

Int. J. Chem. Kinet.
International Journal of Chemical Kinetics (U. S.)

Int. J. Electron.
International Journal of Electronics (Formerly Journal of Electronics and Control) (England)

Int. J. Environ. Stud.
International Journal of Environmental Studies, The (England)

Int. J. Heat Mass Transfer
International Journal of Heat and Mass Transfer (England)

Int. J. Magn.
International Journal of Magnetism (England - U. S.)

Int. J. Nondestruct. Test.
International Journal of Nondestructive Testing (U.S.)

Int. J. Powder Met.
International Journal of Powder Metallurgy (U.S.)

Int. J. Quant. Chem.
International Journal of Quantum Chemistry (U.S.)

Int. J. Quant. Chem., Symp.
International Journal of Quantum Chemistry, Symposium (U.S.)

Int. J. Radiat. Biol.
International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine (England)

Int. J. Radiat. Phys. Chem.
International Journal for Radiation Physics and Chemistry (England)

Int. J. Theor. Phys.
International Journal of Theoretical Physics (England)

Int. Rev. Exp. Pathol.
International Review of Experimental Pathology (U.S.)

Int. Z. Klin. Pharmakol., Ther. Toxikol.
International Zeitschrift fuer Klinische Pharmakologie, Therapie und Toxikologie (West Germany)

Invest. Ophthalmol.
Investigative Ophthalmology (U.S.)

Inzh.-Fiz. Zh.
Inzhenerno-Fizicheskii Zhurnal (Formerly Inzhenerno-Fizicheskii Zhurnal, Akademii Nauk Belorusskoi SSR) (Belorussian S.S.R.)

Ionos. Issled.
Ionosfernye Issledovaniya (U.S.S.R.)

Iowa Dent. J.
Iowa Dental Journal (U. S.)

Iron Age
Iron Age (U.S.)

Irrig. Power
Irrigation and Power (India)

ISA (Instrum. Soc. Amer.) Trans.
ISA (Instrument Society of America) Transactions (U.S.)

Isotope Ind. Landwirt.
Isotope in Industrie und Landwirtschaft (Austria)

Isotopenpraxis
Isotopenpraxis (East Germany)

Isotope Radiat. Res.
Isotope and Radiation Research (Egypt)

Isotop. Radiat. Technol.
Isotopes and Radiation Technology (A Quarterly Technical Progress Review) (U.S.)

Israel J. Agr. Res. (Ktavim)
Israel Journal of Agricultural Research (Ktavim) (Israel)

Israel J. Chem.
Israel Journal of Chemistry (Supersedes Bulletin of the Research Council of Israel, Section A Chemistry) (Israel)

Israel J. Med. Sci.
Israel Journal of Medical Sciences (Israel)

Istanbul Univ. Fen Fak. Mecm., Seri A
Istanbul Universitesi fen Fakultesi Mecmuasi, Seri A (Turkey)

Istanbul Univ. Fen Fak. Mecm., Seri C
Istanbul Universitesi fen Faultesi Mecmuasi, Seri C Astronomi-Fizik (Turkey)

Izmer. Tekh.
Izmeritel'naya Tekhnika (U.S.S.R.)
For English Translation see Measurement Techniques (USSR)

Izotopy SSSR
Izotopy v SSSR (U.S.S.R.)

Izv. Akad. Nauk Arm. SSR, Ser. Fiz.
Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Fizika (Formerly part of Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Fiziko-Matematicheskikh Nauk) (Armenian S.S.R.)

Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk
Izvestiya Akademii Nauk Azerbaidzhanskoi SSR, Seriya Fiziko-Tekhnicheskikh i Matematicheskikh Nauk (Azerbaidzhan S.S.R.)

Izv. Akad. Nauk Est. SSR, Biol.
Izvestiya Akademii Nauk Estonskoi SSR, Biologiya (Formerly Izvestiya Akademii Nauk Estonskoi SSR, Seriya Biologicheskaya) (Estonian S.S.R.)

Izv. Akad. Nauk Est. SSR, Fiz. Mat.
Izvestiya Akademii Nauk Estonskoi SSR, Fizika Matematika (Estonian S.S.R.) (Formerly a Part of Izvestiya Akademii Nauk Estonskoi SSR, Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk) (Estonian S.S.R.)

Izv. Akad. Nauk Kaz. SSR, Ser. Biol.
Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Biologicheskaya (Formerly Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Biologicheskikh Nauk) (Kazakh S.S.R.)

Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.
Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Fiziko-Matematicheskaya (Formerly Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Fiziko-Matematicheskikh Nauk) (Kazakh S.S.R.)

Izv. Akad. Nauk Kaz. SSR, Ser. Khim.
Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Khimicheskaya (Kazakh S.S.R.)

Izv. Akad. Nauk Kirg. SSR
Izvestiya Akademii Nauk Kirgizskoi SSR (Kirgiz S.S.R.)

Izv. Akad. Nauk SSSR, Energ. Transp.
Izvestiya Akademii Nauk SSSR, Energetika i Transport (U.S.S.R.)

Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana
Izvestiya Akademii Nauk SSSR, Fizika Atmosfery i Okeana (U.S.S.R.)

Izv. Akad. Nauk SSSR, Fiz. Zemli
Izvestiya Akademii Nauk SSSR, Fizika Zemli (U.S.S.R.)

Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza
Izvestiya Akademii Nauk SSSR, Mekhanika Zhidkosti i Gaza (U.S.S.R.)
Issued in English Translation as Soviet Fluid Mechanics

Izv. Akad. Nauk SSSR, Metal.
Izvestiya Akademiya Nauk SSSR, Metally (Formerly Izvestiya Akademiya Nauk SSSR, Metallurgiya, Gornoe Delo) (U.S.S.R.)
Issued in English Translation as Russian Metallurgy

Izv. Akad. Nauk SSSR, Ser. Biol.
Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya (U.S.S.R.)

Izv. Akad. Nauk SSSR, Ser. Fiz.
Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya (U.S.S.R.)
Issued in English Translation as Bull. Acad. Sci., USSR, Phys. Ser.

Izv. Akad. Nauk SSSR, Ser. Geol.
Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya (U.S.S.R.)

Izv. Akad. Nauk SSSR, Ser. Khim.
Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya (U.S.S.R.)
Issued in English Translation as Bull. Acad. Sci., USSR, Div. Chem. Sci.

Izv. Akad. Nauk Turkm. SSR, Ser. Biol. Nauk
Izvestiya Akademiya Nauk Turkmenskoi SSR, Seriya Biologicheskikh Nauk (Turkmen S.S.R.)

Izv. Akad. Nauk Turkm. SSR, Ser. Fiz.-Tekh., Khim. Geol. Nauk
Izvestiya Akademii Nauk Turkmenskoi SSR, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk (Turkmen S.S.R.)

Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk
Izvestiya Akademii Nauk Uzbekskoi SSR, Seriya Fiziko-Matematicheskikh Nauk (Uzbek S.S.R.)

Izv. Geofiz. Inst., Bulg. Akad. Nauk.
Izvestiya na Geofizichniya Institut, Bulgarska Akademiya na Naukite, Otdelenie a Matematicheski i Fizicheski Nauki (Bulgaria)

Izv. Krym. Astrofiz. Observ.
Izvestiya Krymskoi Astrofizicheskoi Observatorii (U.S.S.R.)

Izv. Mikrobiol. Inst., Bulg. Akad. Nauk.
Izvestiya na Mikrobiologicheskiya Institut, Bulgarska Akademiya na Naukite (Bulgaria)

Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk
Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Khimicheskikh Nauk (U.S.S.R.)
Issued in English Translation as Siberian Chemistry Journal

Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk
Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Tekhnicheskikh Nauk (U.S.S.R.)

Izv. Timiryazev. Sel'skokhoz. Akad.
Izvestiya Timiryazevskoi Sel'skokhozyaistvennoi Akademii (U.S.S.R.)

Izv. Tomsk. Politekh. Inst.
Izvestiya Tomskogo Politekhnicheskogo Instituta imeni S. M. Kirova (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh.
Izvestiya Vysshikh Uchebnykh Zavedenii, Aviatsionnaya Tekhnika (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Chern. Met.
Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Elektromekh.
Izvestiya Vysshikh Uchebnikh Zavedenii, Elektromekhanika (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Fiz.
Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika (U.S.S.R.)
Issued in English translation as Soviet Physics Journal

Izv. Vyssh. Ucheb. Zaved., Geol. Razved.
Izvestiya Vysshikh Uchebnykh Zavedenii, Geologiya i Razvedka (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.
Izvestiya Vysshikh Uchebnykh Zavedenii, Gornyi Zhurnal (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.
Izvestiya Vysshikh Uchebnykh Zavedenii, Khimiya i Khimicheskaya Tekhnologiya (U.S.S.R.)
(U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Mashinostr.
Izvestiya Vysshikh Uchebnykh Zavedenii, Mashinostroenie
(U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Mat.
Izvestiya Vysshikh Uchebnykh Zavedenii, Matematika
(U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Radioelektron.
Izvestiya Vysshikh Uchebnykh Zavedenii, Radioelektronika
(Ukrainian S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Radiofiz.
Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika
(U.S.S.R.)
Issued in English Translation as Soviet Radiophysics

Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.
Izvestiya Vysshikh Uchebnykh Zavedenii, Tsvetnaya Metallurgiya (U.S.S.R.)

J

Jad. Energ.
Jaderna Energie (Czechoslovakia)

J. Aerosol Sci.
Journal of Aerosol Science (England)

J. Agr. Food Chem.
Journal of Agricultural and Food Chemistry (U.S.)

J. Agr. Univ. Puerto Rico
Journal of Agriculture of the University of Puerto Rico, The (Puerto Rico)

J. Air Pollut. Contr. Ass.
Journal of the Air Pollution Control Association (U.S.)

J. Amer. Ceram. Soc.
Journal of The American Ceramic Society (U.S.)

J. Amer. Chem. Soc.
Journal of The American Chemical Society (U.S.)

J. Amer. Dent. Ass.
Journal of The American Dental Association, The (U.S.)

J. Amer. Geriat. Soc.
Journal of The American Geriatrics Society (U.S.)

J. Amer. Med. Ass.
Journal of The American Medical Association (U.S.)

J. Amer. Podiat. Ass.
Journal of The American Podiatry Association (U.S.)

J. Amer. Water Works Ass.
Journal of The American Water Works Association (U.S.)

J. Anat.
Journal of Anatomy (England)

J. Anim. Sci.
Journal of Animal Science (U.S.)

Jap. Anal.
Japan Analyst (Bunseki Kagaku) (Japan)

Jap. Heart J.
Japanese Heart Journal (Japan)

Jap. J. Appl. Phys.
Japanese Journal of Applied Physics (Japan)

Jap. J. Exp. Med.
Japanese Journal of Experimental Medicine, The (Japan)

Jap. J. Genet.
Japanese Journal of Genetics (Idengaku Zasshi) (Japan)

Jap. J. Microbiol.
Japanese Journal of Microbiology (Japan)

J. Appl. Bacteriol.
Journal of Applied Bacteriology (England)

J. Appl. Chem. Biotechnol.
Journal of Applied Chemistry and Biotechnology (England)
Supersedes J. Appl. Chem. (London)

J. Appl. Chem. (London)
Journal of Applied Chemistry (London) (England)
Changed to J. Appl. Chem. Biotechnol.

J. Appl. Chem. USSR (Engl. Transl.)
Journal of Applied Chemistry of the USSR (English Translation of Zhurnal Prikladnoi Khimii) (U.S.)

J. Appl. Crystallogr.
Journal of Applied Crystallography (Denmark)

J. Appl. Mech.
Journal of Applied Mechanics, Transactions of The ASME, Series E (U.S.)

J. Appl. Meteorol.
Journal of Applied Meteorology (U.S.)

J. Appl. Phys.
Journal of Applied Physics (U.S.)

J. Appl. Polym. Sci.
Journal of Applied Polymer Science (U.S.)

J. Ass. Offic. Anal. Chem.
Journal of the Association of Official Analytical Chemists (Formerly Journal of the Association of Official Agricultural Chemists) (U.S.)

J. Atmos. Terrest. Phys.
Journal of Atmospheric and Terrestrial Physics (Northern Ireland)

J. Aust. Ceram. Soc.
Journal of the Australian Ceramic Society (Australia)

J. Aust. Inst. Metals
Journal of the Australian Institute of Metals (Australia)

J. Bacteriol.
Journal of Bacteriology (U.S.)

J. Basic Eng.
Journal of Basic Engineering, Transactions of The ASME, Series D (U.S.)

J. Belge Radiol.
Journal Belge de Radiologie (Belgium)

J. Biol. Chem.
Journal of Biological Chemistry, The (U.S.)

J. Biol. Med. Nucl.
Journal de Biologie et de Medecine Nucleaires. Supplement au Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire) (France)

J. Brit. Astron. Ass.
Journal of the British Astronomical Association (England)

J. Brit. Nucl. Energy Soc.
Journal of the British Nuclear Energy Society, The (Formerly Journal of the British Nuclear Energy Conference) (England)

J. Can. Ass. Radiol.
Journal of the Canadian Association of Radiologists (Canada)

J. Catal.
Journal of Catalysis (U.S.)

J. Cell Biol.
Journal of Cell Biology, The (Formerly Journal of Biophysical and Biochemical Cytology) (U.S.)

J. Cell. Physiol.
Journal of Cellular Physiology (Formerly Journal of Cellular and Comparative Physiology) (U.S.)

J. Cell Sci.
Journal of Cell Science (England)

J. Chem. Educ.
Journal of Chemical Education (U.S.)

J. Chem. Eng. Data
Journal of Chemical and Engineering Data (U.S.)

J. Chem. Phys.
Journal of Chemical Physics, The (U.S.)

J. Chem. Soc., A
Journal of the Chemical Society (London), A. Inorganic Physical Theoretical (Formerly a Part of Journal of the Chemical Society (London)) (England)

J. Chem. Soc., B
Journal of The Chemical Society (London), B. Physical Organic (Formerly a Part of Journal of The Chemical Society (London)) (England)

J. Chem. Soc., D
Journal of the Chemical Society, D (Formerly Chemical Communications) (England)

J. Chem. Thermodyn.
Journal of Chemical Thermodynamics, The (England - U.S.)

J. Chem. U.A.R.
Journal of Chemistry of The U.A.R. (U.A.R.)
Changed to United Arab Republic Journal of Chemistry

J. Chim. Phys.
Journal de Chimie Physique et de Physico-Chimie Biologique (France)

J. Chromatogr.
Journal of Chromatography (Netherlands)

J. Clin. Endocrinol. Metab.
Journal of Clinical Endocrinology and Metabolism, The (U.S.)

J. Colloid Interface Sci.
Journal of Colloid and Interface Science (Formerly Journal of Colloid Science) (U.S.)

J. Comput. Phys.
Journal of Computational Physics (U.S.)

J. Cryst. Growth
Journal of Crystal Growth (Netherlands)

J. Dairy Res.
Journal of Dairy Research, The (England)

J. Dairy Sci.
Journal of Dairy Science (U.S.)

J. Dent. Ass. S. Afr.
Journal of the Dental Association of South Africa (South Africa)

J. Dent. Res.
Journal of Dental Research, The (U.S.)

J. Econ. Entomol.
Journal of Economic Entomology (U.S.)

J. Egypt. Public Health Ass.
Journal of the Egyptian Public Health Association (Egypt)

J. Electrochem. Soc.
Journal of the Electrochemical Society (U.S.)

Jena Rev.
Jena Review (East Germany)

JETP Lett. (USSR) (Engl. Transl.)
JETP Letters (USSR) (English Translation of Zhurnal Eksperimental'nci i Teoreticheskoi Fiziki, Pisma v Redaktsiyu) (U.S.)

J. Exp. Med.
Journal of Experimental Medicine (U.S.)

J. Fish. Res. Board Can.
Journal of the Fisheries Research Board of Canada (Canada)

J. Fluid Mech.
Journal of Fluid Mechanics (England)

J. Food Sci.
Journal of Food Science (U.S.)

J. Forensic Sci.
Journal of Forensic Sciences (U.S.)

J. Forensic Sci. Soc.
Journal of the Forensic Science Society (England)

J. Forest.
Journal of Forestry (U.S.)

J. Gen. Microbiol.
Journal of General Microbiology, The (England)

J. Gen. Virol.
Journal of General Virology (England)

J. Geomagnet. Geoelec.
Journal of Geomagnetism and Geoelectricity (Japan)

J. Geophys. Res.
Journal of Geophysical Research (U.S.)

J. Gerontol.
Journal of Gerontology (U.S.)

J. Heat Transfer
Journal of Heat Transfer, Transactions of the ASME (American Society of Mechanical Engineers), Series C (U.S.)

J. Helminthol.
Journal of Helminthology (England)

J. Histochem. Cytochem.
Journal of Histochemistry and Cytochemistry, The (U.S.)

J. Hyg.
Journal of Hygiene, The (England)

Jibi To Rinsho
Jibi To Rinsho (Otologia Fukuoka) (Japan)

J. Immunol.
Journal of Immunology (U.S.)

J. Indian Bot. Soc.
Journal of the Indian Botanical Society (India)

J. Indian Chem. Soc.
Journal of the Indian Chemical Society (India)

J. Indian Dent. Ass.
Journal of the Indian Dental Association (India)

J. Indian Inst. Sci.
Journal of the Indian Institute of Science (India)

J. Inorg. Nucl. Chem.
Journal of Inorganic and Nuclear Chemistry (England)

J. Insect Physiol.
Journal of Insect Physiology (U. S.)

J. Inst. Eng. (India), Elec. Eng. Div.
Journal of the Institution of Engineers (India), Electrical Engineering Division (India)

J. Inst. Math. Appl.
Journal of the Institute of Mathematics and Its Applications (England)

J. Inst. Nucl. Eng.
Journal of the Institution of Nuclear Engineers (England)
Supersedes Nuclear Energy

J. Invertebr. Pathol.
Journal of Invertebrate Pathology (U.S.)

J. Invest. Dermatol.
Journal of Investigative Dermatology, The (U.S.)

J. Iowa Med. Soc.
Journal of the Iowa Medical Society (U.S.)

J. Iron Steel Inst. (London)
Journal of the Iron and Steel Institute (London) (England)

J. Jap. Inst. Metals
Journal of the Japan Institute of Metals (Nippon Kinzoku Gakkaishi) (Japan)

J. Karnatak Univ.
Journal of the Karnatak University (India)

J. Korean Agr. Chem. Soc.
Journal of the Korean Agricultural Chemical Society (Hankuk Nonghwahakhoe-ji) (South Korea)

J. Korean Inst. Elec. Eng.
Journal of the Korean Institute of Electrical Engineers, The (Daehan Jeonkihakhoe-ji) (South Korea)

J. Korean Inst. Metals
Journal of the Korean Institute of Metals (South Korea)

J. Korean Nucl. Soc.
Journal of the Korean Nuclear Society (South Korea)

J. Korean Phys. Soc.
Journal of the Korean Physical Society (South Korea)

J. Lab. Clin. Med.
Journal of Laboratory and Clinical Medicine, The (U.S.)

J. Label. Compounds
Journal of Labelled Compounds (Belgium)

J. Less-Common Metals
Journal of the Less-Common Metals (Netherlands)

J. Low Temp. Phys.
Journal of Low Temperature Physics (U.S.)

J. Lumin.
Journal of Luminescence (Netherlands)

J. Macromol. Sci., Part A
Journal of Macromolecular Science, Part A. Chemistry (Supersedes Journal of Macromolecular Chemistry) (U.S.)

J. Magn. Resonance
Journal of Magnetic Resonance (England)

J. Mammalogy
Journal of Mammalogy (U.S.)

J. Mar. Biol. Ass. U.K.
Journal of the Marine Biological Association of The United Kingdom (England)

J. Mater.
Journal of Materials (U.S.)

J. Mater. Sci.
Journal of Materials Science (England)

J. Math. Anal. Appl.
Journal of Mathematical Analysis and Applications (U.S.)

J. Math. Phys. (N.Y.)
Journal of Mathematical Physics (New York) (U.S.)

J. Mec.
Journal de Mecanique (France)

J. Mech. Eng. Sci.
Journal of Mechanical Engineering Science, The (England)

J. Mech. Lab. Jap.
Journal of the Mechanical Laboratory of Japan (Japan)

J. Mech. Phys. Solids
Journal of the Mechanics and Physics of Solids (England)

J. Med. (Basel)
Journal of Medicine (Basel) (Switzerland)
Supersedes Medicina Experimentalis

J. Med. Chem.
Journal of Medicinal Chemistry (U.S.)

J. Med. Microbiol.
Journal of Medical Microbiology (Scotland)

J. Metals
Journal of Metals (U.S.)

J. Meteorol. Soc. Jap.
Journal of the Meteorological Society of Japan (Japan)

J. Microscop.
Journal de Microscopie (France)

J. Milk Food Technol.
Journal of Milk and Food Technology (U.S.)

J. Mol. Biol.
Journal of Molecular Biology (England)

J. Mol. Spectrosc.
Journal of Molecular Spectroscopy (U.S.)

J. Mol. Struct.
Journal of Molecular Structure (Netherlands)

J. Nat. Cancer Inst.
Journal of the National Cancer Institute (U.S.)

J. Natur. Sci. Math.
Journal of Natural Sciences and Mathematics (Pakistan)

J. Neurochem.
Journal of Neurochemistry (England)

J. Norw. Med. Ass.
Journal of the Norwegian Medical Association (Norway)

J. Nucl. Biol. Med.
Journal of Nuclear Biology and Medicine (Supersedes in Part Minerva Nucleare) (Italy)

J. Nucl. Energy
Journal of Nuclear Energy (Formerly Journal of Nuclear Energy, Parts A and B, Reactor Science and Technology) (England)

J. Nucl. Mater.
Journal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands)

J. Nucl. Med.
Journal of Nuclear Medicine (U.S.)

J. Nucl. Med., Suppl.
Journal of Nuclear Medicine, Supplement (U.S.)

J. Nucl. Sci. (Seoul)
Journal of Nuclear Sciences (Seoul) (Wonjaryogwon. Yon gu Nonmun Chip) (South Korea)

J. Nucl. Sci. Technol. (Tokyo)
Journal of Nuclear Science and Technology (Tokyo) (Japan)

J. Nutr.
Journal of Nutrition, The (U.S.)

J. Occup. Med.
Journal of Occupational Medicine (U.S.)

J. Optimization Theory Appl.
Journal of Optimization Theory and Applications (U.S.)

J. Opt. Soc. Amer.
Journal of the Optical Society of America (U.S.)

J. Oral Med.
Journal of Oral Medicine (U. S.)

J. Oral Surg.
Journal of Oral Surgery (U.S.)

J. Org. Chem.
Journal of Organic Chemistry, The (U.S.)

J. Osaka City Med. Cent.
Journal of the Osaka City Medical Center, The (Osaka-Shiritsu Daigaku Igaku Zasshi) (Japan)

J. Parasitol.
Journal of Parasitology, The (U.S.)

J. Pathol.
Journal of Pathology (Formerly Journal of Pathology and Bacteriology, The) (Scotland)

J. Pediat.
Journal of Pediatrics, The (U.S.)

J. Pharm. Sci.
Journal of Pharmaceutical Sciences (U.S.)

J. Phys. (Paris)
Journal de Physique (Paris) (Formerly le Journal de Physique et le Radium) (France)

J. Phys. (Paris), Colloq.
Journal de Physique (Paris), Colloque (France)

J. Phys., A (London)
Journal of Physics, A (London). Proceedings of the Physical Society (General) (Supersedes in Part Proceedings of the Physical Society (London)) (England)

J. Phys., B (London)
Journal of Physics, B (London). Proceedings of the Physical Society (Atomic and Molecular Physics) (Supersedes in Part Proceedings of the Physical Society (London)) (England)

J. Phys., C (London)
Journal of Physics, C (London) Proceedings of the Physical Society (Solid State Physics) (Supersedes in Part Proceedings of the Physical Society (London)) (England)

J. Phys., D (London)
Journal of Physics, D (London) (Supersedes British Journal of Applied Physics) (England)

J. Phys., E (London)
Journal of Physics, E (Supersedes Journal of Scientific Instruments) (England)

J. Phys., F (London)
Journal of Physics, F (London). Metal Physics (England)

J. Phys. Chem.
Journal of Physical Chemistry, The (U.S.)

J. Phys. Chem. Solids
Journal of Physics and Chemistry of Solids (Formerly Physics and Chemistry of Solids, The) (England)

J. Physiol. (London)
Journal of Physiology, The (London) (England)

J. Physiol. (Paris)
Journal de Physiologie (Paris) (France)

J. Physiol. (Paris), Suppl.
Journal de Physiologie (Paris), Supplement (France)

J. Phys. Soc. Jap.
Journal of the Physical Society of Japan (Japan)

J. Plasma Phys.
Journal of Plasma Physics (England)

J. Polym. Sci., Part A-1
Journal of Polymer Science, Part A-1 Polymer Chemistry (U.S.)

J. Polym. Sci., Part A-2
Journal of Polymer Science, Part A-2 Polymer Physics (U.S.)

J. Polym. Sci., Part B
Journal of Polymer Science, Part B Polymer Letters (U.S.)

J. Polym. Sci., Part C
Journal of Polymer Science, Part C Polymer Symposia (U.S.)

J. Power Div., Amer. Soc. Civil Eng.
Journal of the Power Division, Proceedings of the American Society of Civil Engineers (U.S.)

J. Prakt. Chem.
Journal fuer Praktische Chemie (East Germany)

J. Proc. Roy. Soc. N. S. W.
Journal and Proceedings of the Royal Society of New South Wales (Australia)

J. Quant. Spectrosc. Radiative Transfer
Journal of Quantitative Spectroscopy and Radiative Transfer (England)

J. Radiat. Res.
Journal of Radiation Research (Japan)

J. Radioanal. Chem.
Journal of Radioanalytical Chemistry (Netherlands-Hungary)

J. Radiol., Electrol., Med. Nucl.
Journal de Radiologie, d'Electrologie, et de Medicine Nucleaire (France)

J. Radio Res. Lab., Tokyo
Journal of the Radio Research Laboratories, Tokyo (Japan)

J. Range Manage.
Journal of Range Management (U. S.)

J. Reprod. Fert.
Journal of Reproduction and Fertility (England)

J. Res. Nat. Bur. Stand., A
Journal of Research of the National Bureau of Standards, A (U.S.)

J. Res. Nat. Bur. Stand., C
Journal of Research of the National Bureau of Standards, C (U.S.)

J. Roy. Astron. Soc. Can.
Journal of the Royal Astronomical Society of Canada (Canada)

J. Roy. Nav. Med. Serv. (London)
Journal of the Royal Naval Medical Service (London) (England)

J. Roy. Soc. West. Aust.
Journal of the Royal Society of Western Australia (Australia)

J. S. Afr. Chem. Inst.
Journal of the South African Chemical Institute (South Africa)

J. S. Afr. Inst. Mining Met.
Journal of the South African Institute of Mining and Metallurgy (South Africa)

J. S. Calif. State Dent. Ass.
Journal of the Southern California State Dental Association (U.S.)

J. Sci. Eng. Res. (India)
Journal of Science and Engineering Research (India)

J. Sci. Food Agr.
Journal of the Science of Food and Agriculture (England)

J. Sci. Ind. Res.
Journal of Scientific and Industrial Research (India)

J. Sci. Med. Lille
Journal des Sciences Medicales de Lille (France)

J. Small Anim. Pract.
Journal of Small Animal Practice (England)
Ceased with Vol. 10, no. 12, 1970

J. Soc. Leather Trades Chem.
Journal of the Society of Leather Trades Chemists (England)

J. Solid State Chem.
Journal of Solid State Chemistry (U. S.)

J. Spacecraft Rockets
Journal of Spacecraft and Rockets (U.S.)

J. Statist. Phys.
Journal of Statistical Physics (U.S. - England)

J. Stored Prod. Res.
Journal of Stored Products Research (England)

J. Strain Anal.
Journal of Strain Analysis (England)

J. Surg. Oncol.
Journal of Surgical Oncology (U. S.)

J. Surg. Res.
Journal of Surgical Research, The (U.S.)

J. Theor. Biol.
Journal of Theoretical Biology (England)

J. Therm. Anal.
Journal of Thermal Analysis (England)

J. Thorac. Cardiovasc. Surg.
Journal of Thoracic and Cardiovascular Surgery (U.S.)

J. Univ. Poona
Journal of the University of Poona (India)

J. Urol.
Journal of Urology, The (U.S.)

J. Vac. Sci. Technol.
Journal of Vacuum Science and Technology, The (U.S.)

J. Virol.
Journal of Virology (U.S.)

J. Wildlife Manage.
Journal of Wildlife Management (U.S.)

K

Kaeltetech.-Klim.
Kaeltetechnik-Klimatisierung (Formerly Kaeltetechnik) (West Germany)

Kagaku (Kyoto)
Kagaku (Kyoto) (Chemistry) (Japan)

Kagaku (Tokyo)
Kagaku (Tokyo) (Science) (Japan)

Kagaku Gijutsucho Geppo
Kagaku Gijutsucho Geppo (Bulletin of the Science and Technology Agency) (Japan)

Kagaku Gijutsushi - MOL
Kagaku Gijutsushi - MOL (Chemical Engineering - MOL) (Japan)

Kagaku Keisatsu Kenkyusho Hokoku
Kagaku Keisatsu Kenkyusho Hokoku (Reports of the National Research Inst. of Police Science) (Japan)

Kagaku No Ryoiki
Kagaku No Ryoiki (Journal of Japanese Chemistry) (Japan)

Kagoshima Daigaku Igaku Zasshi
Kagoshima Daigaku Igaku Zasshi (Medical Journal of Kagoshima University) (Japan)

Kaijo Hoan Daigakko Kenkyu Hokoku, Dai-2-Bu
Kaijo Hoan Daigakko Kenkyu Hokoku, Dai-2-Bu (Journal of Maritime Safety Academy, Part 2) (Japan)

Kajima Kensetsu Gijutsu Kenkyusho Nempo
Kajima Kensetsu Gijutsu Kenkyusho Nempo (Annual Report of The Kajima Construction Technical Research Institute) (Japan)

Kakuriken Kenkyu Hokoku
Kakuriken Kenkyu Hokoku (Research Report of the Laboratory of Nuclear Science, Tohoku University) (Japan)

Kakuyugo Kenkyu
Kakuyugo Kenkyu (Nuclear Fusion Research Report) (Japan)

Kasi Pa Gikyoshi
Kami Pa Gikyoshi (Journal of the Japanese Technical Association) (Japan)

Kanagawa-ken Kogyo Shikenjo Kenkyu Hokoku
Kanagawa-ken Kogyo Shikenjo Kenkyu Hokoku (Bulletin of the Industrial Research Institute of Kanagawa Prefecture) (Japan)

Kansai Ika Daigaku Zasshi
Kansai Ika Daigaku Zasshi (The Journal of the Kansai Medical School) (Japan)

Kardiologiya
Kardiologiya (U.S.S.R.)

Karyoku Hatsuden
Karyoku Hatsuden (The Thermal Power) (Japan)

Kaut. Gummi Kunstst.
Kautschuk und Gummi Kunststoffe (West Germany)

Kazan. Med. Zh.
Kazanskii Meditsinskii Zhurnal (U.S.S.R.)

Keikinzoku
Keikinzoku (Light Metals (Tokyo)) (Japan)

Keikinzoku Yosetsu
Keikinzoku Yosetsu (Japan Light Metal Welding) (Japan)

Keiso
Keiso (Instrumentation) (Japan)

Keisoku To Seigyo
Keisoku To Seigyo (Journal of the Society of Instrument and Control Engineers) (Japan)

Kem. Kozlem.
Kemiai Kozlemenyek (Formerly Magyar Tudomanyos Akademia Kemiai Tudomanyos Osztalyanak Kozlemenyei) (Hungary)

Kensetsu No Kikaika
Kensetsu No Kikaika (Construction Mechanization) (Japan)

Kernenergie
Kernenergie (East Germany)

Kerntechnik
Kerntechnik Vereinigt mit Atompraxis. The Journal for Nuclear Engineers and Scientists (West Germany)

KFKI (Kozp. Fiz. Kut. Intez.) Kozlem.
KFKI (Kozponti Fizikai Kutato Intezet) Kozlemenyek (Hungary)
Ceased publication

Kgl. Dan. Vidensk. Selsk., Mat.-Fys. Medd.
Kongelige Danske Videnskabernes Selskab, Det, Matematisk-Fysisk Meddelelser (Denmark)

Khig. Zdraveopazvane
Khigiena i Zdraveopazvane (Bulgaria)

Khim. Drev.
Khimiya Drevesiny (Latvian S.S.R.)

Khim. Neft. Mashinostr.
Khimicheskoe i Neftyanoe Mashinostroenie (U.S.S.R.)
Issued in English translation as Chemical and Petroleum Engineering (USSR)

Khim. Prom. Ukr.
Khimicheskaya Promyshlennost Ukrainy (Ukrainian S.S.R.)

Khim. Sel. Khoz.
Khimiya v Sel'skom Khozyaistve (U.S.S.R.)

Khim. Tverd. Topl.
Khimiya Tverdogo Topliva (U.S.S.R.)

Khim. Vys. Energ.
Khimiya Vysokikh Energii (U.S.S.R.)
Issued in English Translation as High Energy Chemistry (USSR)

Kibernetika
Kibernetika (Ukrainian S.S.R.)

Kinet. Catal. (USSR) (Engl. Transl.)
Kinetics and Catalysis (USSR) (English Translation of Kinetika i Kataliz) (U.S.)

Kinet. Katal.
Kinetika i Kataliz (U.S.S.R.)
Issued in English Translation as Kinetics and Catalysis (USSR)

Kinki Daigaku Genshiryoku Kenkyusho Nenpo
Kinki Daigaku Genshiryoku Kenkyusho Nenpo (Annual Reports of Kinki University Atomic Energy Research Institute) (Japan)

Kinzoku Zairyo
Kinzoku Zairyo (Metals in Engineering) (Japan)

Kiserl. Orvostud.
Kiserletes Orvostudomany (Hungary)

Kitakanto Igaku
Kitakanto Igaku (Kitakanto Medical Journal) (Japan)

Kjemi
Kjemi (Formerly Tidsskrift for Kjemi, Bergvesen og Metallurgi) (Norway)

Klepzig Fachber.
Klepzig Fachberichte fuer die Fuehrungskraefte aus Maschinenbau und Huettenwesen (Formerly Klepzigs Anzeiger fuer die Berg-, Huetten-, Metall- und Maschinenindustrie) (West Germany)

Klin. Khir.
Klinicheskaya Khirurgiya (Ukrainian S.S.R.)

Klin. Med. (Moscow)
Klinicheskaya Meditsina (Moscow) (U.S.S.R.)

Klin. Oczna
Klinika Oczna (Poland)

Klin. Wochensch.
Klinische Wochenschrift (West Germany)

Koatsuryoku
Koatsuryoku (High Pressure) (Japan)

Kobe Seiko Giho
Kobe Seiko Giho (Kobe Steel Works Engineering Reports) (Japan)
Superseded by R and D, Kobe Seiko Giho

Kobunshi Kagaku
Kobunshi Kagaku (Chemistry of High Polymers) (Japan)

Kogyo Gijutsu
Kogyo Gijutsu (Industrial Science and Technology) (Japan)

Kogyo Kagaku Zasshi
Kogyo Kagaku Zasshi (Japan)

Kokobyo Gakkai Zasshi
Kokobyo Gakkai Zasshi (The Journal of the Japan Stomatological Society) (Japan)

Kokuritsu Eiyo Kenkyusho Kenkyu Hokoku
Kokuritsu Eiyo Kenkyusho Kenkyu Hokoku (Research Report of the National Institute of Nutrition) (Japan)

Kolloid. Zh.
Kolloidnyi Zhurnal (Colloid Journal) (U.S.S.R.)
Issued in English translation as Colloid Journal (USSR)

Kolloid-Z. Z. Polym.
Kolloid-Zeitschrift und Zeitschrift fuer Polymere, zur Zeit Vereinigt mit den Kolloid-Beiheften (Formerly Kolloid-Zeitschrift, -Zeitschrift fuer Polymere) (West Germany)

Kon. Ned. Akad. Wetensch., Proc., Ser. B
Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B (Netherlands)

Konstr. Masch.-, App.- Geraetebau
Konstruktion im Maschinen-, Apparate- und Geraetebau (West Germany)

Konst. Svoistva Miner.
Konstitutsiya i Svoistva Mineralov (Ukrainian S.S.R.)

Korean J. Bot.
Korean Journal of Botany (South Korea)

Korean J. Microbiol.
Korean Journal of Microbiology (South Korea)

Koshu Eiseiin Kenkyu Hokoku
Koshu Eiseiin Kenkyu Hokoku (Bulletin of the Institute of Public Health) (Japan)

Kosm. Biol. Med.
Kosmicheskaya Biologiya i Meditsina (U.S.S.R.)
Issued in English Translation as Space Biology and Medicine (USSR)

Kosm. Issled.
Kosmicheskie Issledovaniya (U.S.S.R.)
Issued in English Translation as Cosmic Research (USSR)

Kosm. Luchi
Kosmicheskie Luchi (U.S.S.R.)

Kratk. Soobshch. Fiz.
Kratkie Soobshcheniya po Fizike (U.S.S.R.)

Kumamoto Igakkai Zasshi
Kumamoto Igakkai Zasshi (The Journal of the Kumamoto Medical Society) (Japan)

Kunststoffe
Kunststoffe. Organ der Deutschen Kunstoff-Fachverbaende (West Germany)

Kunstst.-Rundsch.
Kunststoff-Rundschau (West Germany)

Kuznechno-Shtampovochnoe Proizvod.
Kuznechno-Shtampovochnoe Proizvodstvo (U.S.S.R.)

Kyoto Daigaku Kogaku Kenkyusho Iho
Kyoto Daigaku Kogaku Kenkyusho Iho (Bulletin of the Engineering Research Institute of Kyoto University (Japan)

Kyoto Furitsu Ika Daigaku Zasshi
Kyoto Furitsu Ika Daigaku Zasshi (Journal of Kyoto Prefectural Medical University) (Japan)

Kyushu Daigaku Kogaku Shuho
Kyushu Daigaku Kogaku Shuho (Technology Reports of the Kyushu University) (Japan)

Kyushu Daigaku Nogakubu Gakugei Zasshi
Kyushu Daigaku Nogakubu Gakugei Zasshi (Science Bulletin of the Faculty of Agriculture, Kyushu University) (Japan)

L

Lab. Anim. Care
Laboratory Animal Care (U.S.)

Lab. Delo
Laboratornoe Delo (U.S.S.R.)

Lab. Pract.
Laboratory Practice (England)

Laekartidningen
Laekartidningen (Sweden)
Supersedes Svenska Laekartidningen

Lait
Lait, Le. Revue Generale des Questions Laiteres (France)

Lakokrasoch. Mater. Ikh Primen.
Lakokrasochnye Materialy i Ikh Primenenie (U.S.S.R.)

Lancet
Lancet, The (England)

Langenbecks Arch. Chir.
Langenbecks Archiv fuer Chirurgie (Formerly Archiv fuer Klinische Chirurgie, Langenbecks) (West Germany)

Lantbrukshogsk. Ann.
Lantbrukshogskolans Annaler (Sweden)

Laryngoscope
Laryngoscope, The (U.S.)

Latv. PSR Zinat. Akad. Vestis
Latvijas PSR Zinatnu Akademijas Vestis (Latvian S.S.R.)

Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.
Latvijas PSR Zinatnu Akademijas Vestis, Fizikas un Tehnisko Zinatnu Serija (Latvian S.S.R.)

Laval Med.
Laval Medical (Canada)

Lebensm.-Wiss. Technol.
Lebensmittel-Wissenschaft und Technologie (Switzerland)

Lek. Obz.
Lekarsky Obzor (Czechoslovakia)

Lett. Nuovo Cim.
Lettere al Nuovo Cimento (Italy)

Liet. Fiz. Rinkinys
Lietuvos Fizikos Rinkinys (Lithuanian S.S.R.)

Liet. TSR Aukst. Mokyklu Mokslo Darb., Chem. Chem. Technol.
Lietuvos TSR Aukstu ju Mokyklu Mokslo Darbai, Chemija ir Chemine Technologija (Lithuanian S.S.R.)

Liet. TSR Mokslu Akad. Darbai, Ser. B
Lietuvos TSR Mokslu Akademija Darbai, Serija B
(Lithuanian S.S.R.)

Life Sci., Part I
Life Sciences, Part I. Physiology and Pharmacology
(U. S. - England)

Life Sci., Part II
Life Sciences, Part II. Biochemistry, General and Molecular Biology (U. S. - England)

Limnol. Oceanogr.
Limnology and Oceanography (U.S.)

Linde Ber. Tech. Wiss.
Linde Berichte aus Technik und Wissenschaft (West Germany)

Lipids
Lipids (U.S.)

Liteinoe Proizvod.
Liteinoe Proizvodstvo (U.S.S.R.)

Litol. Polez. Iskop.
Litologiya i Poleznye Iskopaemye (U.S.S.R.)

Lucr. Stiint. Inst. Agron. Ion Ionescu De La Brad, Iasi
Lucrarile Stiintifice. Institutul Agronomic Professor Ion Ionescu De La Brad, Iasi (Romania)

Lucr. Stiint. Inst. Agron. N. Balcescu, Bucuresti, Ser. C
Lucrari Stiintifice ale Institutului Agronomic N. Balcescu, Bucuresti, Seria C (Romania)

Luftfahrttech.-Raumfahrttech.
Luftfahrttechnik-Raumfahrttechnik (West Germany)

Lymphology (Stuttgart)
Lymphology (Stuttgart) (West Germany)

Lyon Chir.
Lyon Chirurgical (France)

M

Maataloustieteellinen Aikak.
Maataloustieteellinen Aikakauskirja (Finland)

Mach. Build. Ind.
Machine Building Industry (India)

Mach. Design
Machine Design (U.S.)

Mach. Outil Fr.
Machine Outil Francaise (France)

Macromolecules
Macromolecules (U.S.)

Mada
Mada (Israel)

Madras Agr. J.
Madras Agricultural Journal (India)

Magn. Gidrodin.
Magnitnaya Gidrodinamika, Akademiya Nauk Latviiskoi SSR (Latvian S.S.R.)
Issued in English translation as Magnetohydrodynamics (USSR)

Magy. Fiz. Foly.
Magyar Fizikai Folyoirat (Hungary)

Magy. Geofiz.
Magyar Geofizika (Hungary)

Magy. Kem. Foly.
Magyar Kemiai Folyoirat (Hungary)

Magy. Kem. Lapja
Magyar Kemikusok Lapja (Hungary)

Magy. Radiol.
Magyar Radiologia (Hungary)

Makromol. Chem.
Makromolekueare Chemie, Die (Switzerland)

Mar. Biol.
Marine Biolcgy (Constitutes Proceedings of the International Interdisciplinary Conference cn Marine Biclogy) (U.S.)

Maroc Med.
Maroc Medical (Morocco)

Mar. Pcllut. Bull.
Marine Pollution Bulletin (England)

Maschinenmarkt
Maschinenmarkt (West Germany)

Maschinenschaden
Maschinenschaden (West Germany)

Maskin
Maskin. Tidsskrift for Maskin og Verkstedteknikk (Norway)

Mater. Eng.
Materials Engineering (Formerly Materials in Design Engineering) (U.S.)

Mater. Eval.
Materials Evaluation (Formerly Ncndestructive Testing) (U.S.)

Materialpruefung
Materialpruefung (West Germany)

Mater. Res. Bull.
Materials Research Bulletin (U.S.)

Mater. Res. Stand.
Materials Research and Standards (Formerly ASTM (Amerlcan Society for Testing Materials) Bulletin) (U.S.)

Mater. Sci. Eng.
Materials Science and Engineering (Netherlands)

Math. Biosci.
Mathematical Biosciences (U.S.)

Mathematica
Mathematica (Romania)

Meas. Contr.
Measurement and Control (Supersedes Transaction of the Society of Instrument Technology) (England)

Meas. Tech. (USSR) (Engl. Transl.)
Measurement Techniques (USSR) (English Translation of Izmeritelnaya Tekhnika) (U.S.)

Meccanica
Meccanica (Italy)

Mech. Eng.
Mechanical Engineering (U.S.)

Meded. Vlaam. Chem. Ver.
Mededelingen van de Vlaamse Chemische Vereniging (Belgium)

Med. Glas.
Medicinski Glasnik (Yugoslavia)

Medicina (Buenos Aires)
Medicina (Buenos Aires) (Argentina)

Medicina (Mex.)
Medicina (Mexico)

Med. J. Aust.
Medical Journal of Australia, The (Australia)

Med. Nucl.-Radiobiol. Lat.
Medicina Nucleare-Radiobiologica Latina (Formerly Radiobiologica Latina) (Italy)

Med. Pracy
Medycyna Pracy (Poland)

Med. Pregl. (Novi Sad)
Medicinski Pregled (Novi Sad) (Yugoslavia)

Med. Probl.
Medicinski Problemi (Bulgaria)

Med. Radiol.
Meditsinskaya Radiologiya (U.S.S.R.)
Issued in English translation as Med. Radiol. (USSR)

Med. Welt
Medizinische Welt, Die (West Germany)

Mekh. Avtomat. Upr.
Mekhanizatsiya I Avtomatizatsiya Upravleniya (Ukrainian S.S.R.)

Mekh. Polim.
Mekhanika Pclimerov (Latvian S.S.R.)

Mem. Chubu Inst. Technol.
Memoirs of Chubu Institute of Technology (Chubu Koygo Daigaku Kyo) (Japan)

Mem. Fac. Eng., Kyoto Univ.
Memoirs of the Faculty of Engineering, Kyoto University (Japan)

Mem. Fac. Eng., Kyushu Univ.
Memoirs of the Faculty of Engineering, Kyushu University (Japan)

Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.
Memoirs of the Faculty of Science, Kyoto University, Series of Physics, Astrophysics, Geophysics, and Chemistry (Formerly Memoirs of the College of Science, University of Kyoto. Series A) (Japan)

Mem. Fac. Sci., Kyushu Univ., Ser. B
Memoirs of the Faculty of Science, Kyushu University, Series B. Physics (Japan)

Mem. Fac. Sci., Kyushu Univ., Ser. C
Memoirs of the Faculty of Science, Kyushu University, Series C (Japan)

Mem. Konan Univ., Sci. Ser.
Memoirs of the Konan University, Science Series (Japan)

Mem. Roy. Astron. Soc.
Memoirs of the Royal Astronomical Society (England)

Mem. Sci. Rev. Met.
Memoires Scientifiques de la Revue de Metallurgie, Les (Formerly a Part of Revue de Metallurgie) (France)

Mem. Soc. Roy. Sci. Liege
Memoires de la Societe Royale des Sciences de Liege (Belgium)

Mem. Soc. Roy. Sci. Liege, Vol. Hors Ser.
Memoires de la Societe Royale des Sciences de Liege, Volume Hors Serie (Belgium)

Metal Constr. Brit. Weld. J.
Metal Construction and British Welding Journal (England)
Supersedes British Welding Journal

Metal Finish.
Metal Finishing (U.S.)

Metall
Metall. Internazionale Zeitschrift fuer Technik und Wirtschaft (West Germany)

Metallgesellschaft
Metallgesellschaft (West Germany)

Metallges., Mitt. Arbeitsbereich
Metallgesellschaft, Mitteilungen aus dem Arbeitsbereich (West Germany)

Metallography
Metallography. An International Journal (U.S.)

Metalloved. Term. Obrab. Metal.
Metallovedenie i Termicheskaya Obrabotka Metallov (Formerly Metallovedenie i Obrabotka Metallov) (U.S.S.R.)
For English Translation see Metal Science and Heat Treatrent (USSR)

Metallurgia
Metallurgia (England)

Metal Progr.
Metal Progress (U.S.)

Metals Aust.
Metals Australia (Australia)

Metal Sci. Heat Treat. (USSR) (Engl. Transl.)
Metal Science and Heat Treatment (USSR) (English Translation of Metallovedenie i Termicheskaya Obrabotka Metallov) (U.S.)

Metal Sci. J.
Metal Science Journal (England)

Metals Eng. Quart.
Metals Engineering Quarterly (U.S.)

Metalurgia (Bucharest)
Metalurgia (Bucharest) (Romania)

Metalurgia (Sao Paulo)
Metalurgia (Sao Paulo) (Brazil)

Metaux (Corros.-Ind.)
Metaux (Corrosion-Industrie) (France)

Metecritika
Meteoritika (U.S.S.R.)

Metecrol. Rundsch.
Meteorologische Rundschau (West Germany)

Method. Phys. Anal.
Methodes Physiques d'Analyse (France)

Methods Exp. Phys.
Methods of Experimental Physics (U.S.)

Met. Ital.
Metallurgia Italiana (Includes the Section Atti Notizie, Associazione Italiana de Metallurgia) (Italy)

Met. Metalloved. Chist. Metal., Sb. Nauch. Rabot
Metallurgiya i Metallovedenie Chistykh Metallov, Moskovskii Inzhenerno-Fizicheskii Institut, Sbornik Nauchnykh Rabot (U.S.S.R.)

Metrologia
Metrologia (West Germany)

Met. Trans.
Metallurgical Transactions (formerly Transactions of the Metallurgical Society of AIME and Transactions Quarterly of American Society for Metals) (U. S.)

Mfg. Eng. Manage.
Manufacturing Engineering and Management (U.S.)
Supersedes ASTME Vectors and The Tool and Manufacturing Engineering

Microchem. J.
Microchemical Journal (U.S.)

Microelectron. Rel.
Microelectronics and Reliability (England)

Microstructures
Microstructures (U. S.)

Mie Med. J.
Mie Medical Journal (Japan)

Mikol. Fitopatol.
Mikologiya i Fitopatologiya (U.S.S.R.)

Mikrobiologiya
Mikrobiologiya (U.S.S.R.)
For English Translation see Microbiology (USSR)

Mikrobiol. Zh.
Mikrobiologichenyi Zhurnal (Ukrainian S.S.R.)

Mikrochim. Acta
Mikrochimica Acta (Formerly Mikrochimica et Ichoanalytica Acta) (Austria)

Milchwissenschaft
Milchwissenschaft (West Germany)

Mil. Med.
Military Medicine (U.S.)

Miner. Deposita
Mineralium Depcsita (West Germany)

Minerva Chir.
Minerva Chirgica (Italy)

Minerva Fisiconucl.
Minerva Fisiconucleare. Giornale di Fisica Sanitaria e Protezione Contro le Radiazioni (Italy)

Minerva Med.
Minerva Medica (Italy)

Minerva Med. Giuliana
Minerva Medica Giuliana. Supplemento a Minerva Medica (Italy)

Minerva Nefrol.
Minerva Nefrologica (Italy)

Minerva Pediat.
Minerva Pediatrica (Italy)

Minerva Radiol.
Minerva Radiologica (Formerly Minerva Radiclogica, Fisicterapica e Radiobiologica) (Italy)

Mining Congr. J.
Mining Congress Journal (U.S.)

Mitsubishi Denki Giho
Mitsubishi Denki Giho (Mitsubishi Denki Technical Review) (Japan)

Mitsubishi Juko Giho
Mitsubishi Juko Giho (Mitsubishi Heavy Industries Technical Review) (Japan)

Mitt. Geb. Lebensmittelunters. Hyg.
Mitteilungen aus dem Gebiete der Lebensmitteluntersuchung und Hygiene (Switzerland)

Mitt. Ver. Grcsskesselbetr.
Mitteilungen der Vereinigung der Grosskesselbetreiber (Formerly Mitteilungen der Vereinigung der Grosskesselbesitzer) (West Germany)

Mod. Geol.
Modern Geology (England)

Mol. Cryst.
Molecular Crystals (England)
Superseded by Molecular Crystals and Liquid Crystals

Mol. Cryst. Liquid Cryst.
Molecular Crystals and Liquid Crystals (formerly Molecular Crystals) (England)

Mol. Gen. Genet.
Molecular and General Genetics (MGG) (Continuation of Zeitschrift fuer Vererbungslehre) (West Germany)

Mol. Phys.
Molecular Physics (England)

Monatsber. Deut. Akad. Wiss. Berlin
Monatsberichte der Deutschen Akademie der Wissenschaften zu Berlin (East Germany)

Monatsh. Chem.
Monatshefte fuer Chemie (Austria)

Monatsschr. Kinderheilk.
Monatsschrift fuer Kinderheilkunde (West Germany)

Mon. Notic. Roy. Astron. Soc.
Monthly Notices of the Royal Astronomical Society (England)

Motor Ship
Motor Ship (England)

Munkavedelem
Munkavedelem (Hungary)

Musz. Tud.
Muszaki Tudomany (Formerly Magyar Tudomanyos Akademia Muszaki Tudomanyok Osztayanak Kozlemenyeia) (Hungary)

Mutat. Res.
Mutation Research (Netherlands)

Mycopathol. Mycol. Appl.
Mycopathologia et Mycologia Applicata (Netherlands)

N

Nagoya J. Med. Sci.
Nagoya Journal of Medical Science, The (Japan)

Nahrung
Nahrung, Die (East Germany)

Naika
Naika (Internal Medicine) (Japan)

Nainen Kikan
Nainen Kikan (Internal Combustion Engine) (Japan)

Nankyoku Shiryo
Nankyoku Shiryo (Antarctic Record) (Japan)

Nat. Saf. News
National Safety News (U. S.)

Nature (London)
Nature (London) (England)

Nature (London) New Biol.
Nature (London) New Biology (England)

Nature (London) Phys. Sci.
Nature (London) Physical Science (England)

Naturwissenschaften
Naturwissenschaften, Die (West Germany)

Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.
Nauchnye Trudy, Gosudarstvennyi Nauchno-Issledovatel'skii i Proektnyi Institut Redkometallicheskoi Promyshlennosti (U.S.S.R.)

Nauch. Tr. Vissh. Med. Inst., Sofia
Nauchni Trudove na Visshiya Meditsinski Ins'itut, Sofia (Bulgaria)

Nav. Eng. J.
Naval Engineers Journal (U.S.)

Nav. Res. Rev.
Naval Research Reviews (U. S.)

Ned. Tijdschr. Geneesk.
Nederlands Tijdschrift voor Geneeskunde (Netherlands)

Ned. Tijdschr. Natuurk.
Nederlands Tijdschrift voor Natuurkunde (Netherlands)

Neftekhimiya
Neftekhimiya (U.S.S.R.)

Nematologica
Nematologica (Netherlands)

Nenryo Kyokai-shi
Nenryo Kyokai-shi (Journal of the Fuel Society of Japan) (Japan)

Neoplasma
Neoplasma (Czechoslovakia)

Nephron
Nephron (Switzerland)

Neue Deliwa-Z.
Neue Deliwa-Zeitschrift zur Foerderung des Gas-, Wasser- und Elektrizitaetsfaches (West Germany)

Neue Huette
Neue Huette (East Germany)

Neue Tech.
Neue Technik (Switzerland)
Supersedes Neue Tech., A and B

Neue Tech., B
Neue Technik, B. Zeitschrift fuer Kerntechnik (Switzerland)
Superseded by Neue Tech.

Neurol., Neurochir. Psychiat. Pol.
Neurologia, Neurochirurgia i Psychiatria Polska (Poland)

Neuropharmacology
Neuropharmacology (England)
Supersedes International Journal of Neuropharmacology

New Phys. (S. Korea)
New Physics (South Korea)

New Phytol.
New Phytologist, The (England)

New Sci.
New Scientist, The (England)
Merged with Science Journal to form New Scientist and Science Journal

New Sci. Sci. J.
New Scientist and Science Journal (England)
Formerly issued separately as New Scientist and Science Journal

Newslett. Environ. Mutagen Soc.
Newsletter of the Environmental Mutagen Society (U. S.)

Nihon Daigaku Seisan Kogakubu Hokoku
Nihon Daigaku Seisan Kogakubu Kokoku (Journal of the College of Industrial Technology, Nihon University) (Japan)

Nippon Butsuri Gakkaishi
Nippon Butsuri Gakkaishi (Proceedings of the Physical Society of Japan) (Japan)

Nippon Gan Chiryo Gakkai-Shi
Nippon Gan Chiryo Gakkai-Shi (Journal of Japan Society for Cancer Therapy, The) (Japan)

Nippon Ganka Gakkai Zasshi
Nippon Ganka Gakkai Zasshi (Acta Societatis Ophthalmologicae Japonicae) (Japan)

Nippon Ganka Kiyo
Nippon Ganka Kiyo (Folia Ophthalmologica Japonica) (Japan)

Nippon Genshiryoku Gakkai Rochuseishi Kenkyu Senmon Iinkai Hokoku
Nippon Genshirycku Gakkai Rochuseishi Kenkyu Senmon Iinkai Hokoku (Japan)

Nippon Genshiryoku Gakkaishi
Nippon Genshiryoku Gakkaishi (Journal of the Atomic Energy Society of Japan) (Japan)

Nippon Hoshasen Gijutsu Gakkai Zasshi
Nippon Hoshasen Gijutsu Gakkai Zasshi (Japanese Journal of Radiological Technology) (Japan)

Nippon Igaku Hoshasen Gakkai Zasshi
Nippon Igaku Hoshasen Gakkai Zasshi (Nippon Acta Radiologica (Japan)

Nippon Kagaku Zasshi
Nippon Kagaku Zasshi (Journal of the Chemistry Society of Japan, Pure Chemistry Section) (Japan)

Nippon Kaisui Gakkaishi
Nippon Kaisui Gakkaishi (Bulletin of the Society of Sea Water Science, Japan) (Japan)

Nippon Kikai Gakkai Ronbunshu
Nippon Kikai Gakkai Ronbunshu (Transactions of the Japanese Society of Mechanical Engineers) (Japan)

Nippon Kikai Gakkaishi
Nippon Kikai Gakkaishi (Journal of the Japan Society of Mechanical Engineers) (Japan)

Nippon Kinzoku Gakkai Kaiho
Nippon Kinzoku Gakkai Kaiho (Bulletin of the Japan Institute of Metals) (Japan)

Nippon Kyobu Geka Gakkai Zasshi
Nippon Kyobu Geka Gakkai Zasshi (Journal of the Japanese Association for Thoracic Surgery) (Japan)

Nippon Kyobu Rinsho
Nippon Kyobu Rinsho (The Japanese Journal of Chest Diseases) (Japan)

Nippon Nogeikagaku Kaishi
Nippon Nogeikagaku Kaishi (Journal of the Agricultural Chemical Society of Japan) (Japan)

Nippon Rinsho
Nippon Rinsho (Japanese Journal of Clinical Medicine) (Japan)

Nippon Sanshigaku Zasshi
Nippon Sanshigaku Zasshi (The Journal of Sericultural Science of Japan) (Japan)

Nippon Shokakibyo Gakkai Zasshi
Nippon Shokakibyo Gakkai Zasshi (The Japanese Journal of Gastroenterology) (Japan)

Nippon Shokuhin Kogyo Gakkaishi
Nippon Shokuhin Kogyo Gakkaishi (Journal of Food Science and Technology) (Japan)

Nippon Shonika Gakkai Zasshi
Nippon Shonika Gakkai Zasshi (Acta Paediatrica Japonica) (Japan)

Nippon Zosen Gakkaishi
Nippon Zosen Gakkaishi (Japan)

Nitrogen
Nitrogen (England)

Nord. Med.
Nordisk Medicin (Sweden)

Norelco Rep.
Norelco Reporter (U.S.)

Norsk Farm. Tidsskr.
Norsk Farmaceutisk Tidsskrift (Norway)

Notas Fis., Cent. Brasil. Pesqui. Fis.
Notas de Fisica, Centro Brasileiro de Pesquisas Fisicas (Brazil)

Nouv. Rev. Fr. Hematol.
Nouvelle Revue Francaise d'Hematologie (France)

Nouv. Rev. Opt. Appl.
Nouvelle Revue d'Optique Appliquee (France)

Nowotwory
Nowotwory (Poland)

Nucl. Active
Nuclear Active (South Africa)

Nucl. Appl. Technol.
Nuclear Applications and Technology (Formerly Nuclear Applications) (U.S.)
Superseded by Nuclear Technology

Nucl. Data, Sect. A
Nuclear Data, Section A (U.S.)

Nucl. Data, Sect. B
Nuclear Data, Section B (U.S.)

Nucl. Energy
Nuclear Energy (Formerly Nuclear Energy Engineer) (England)
Changed to Journal of the Institution of Nuclear Engineers

Nucl. Eng. Des.
Nuclear Engineering and Design (Formerly Nuclear Structural Engineering) (Netherlands)

Nucl. Eng. Int.
Nuclear Engineering International Incorporating Nuclear Power (Formerly Nuclear Engineering) (England)

Nucleus (Chicago)
Nucleus (Chicago), The (U.S.)

Nucleus (Karachi)
Nucleus (Karachi) (Pakistan)

Nucl. Fusion
Nuclear Fusion (Journal of Plasma Physics and Thermonuclear Fusion) (Austria)

Nucl. Hematol. (Publ. Nucl. Energy)
Nuclear Hematology, Nuclear, Space and General Hematology, Elcod Clotting, Immuno-Hematology (Published In Nuclear Energy) (England)

Nucl. Ind.
Nuclear Industry (U.S.)

Nucl. Instrum. Methods
Nuclear Instruments and Methods (Formerly Nuclear Instruments) (Netherlands)

Nucl. Law Bull.
Nuclear Law Bulletin (Belgium)

Nucl. Law Bull., Suppl.
Nuclear Law Bulletin, Supplement (Belgium)

Nucl.-Med.
Nuclear-Medizin (West Germany)

Nucl. Met., Met. Soc. AIME
Nuclear Metallurgy, Metallurgical Society of AIME (American Institute of Mining, Metallurgical and Petroleum Engineers) (U.S.)

Nucl. News
Nuclear News (U.S.)

Nucl. Phys.
Nuclear Physics (Netherlands)
Superseded by Nuclear Physics, A and B (Netherlands)

Nucl. Phys., A
Nuclear Physics, A (Netherlands)

Nucl. Phys., B
Nuclear Physics, B (Netherlands)

Nucl. Safety
Nuclear Safety (A Bimonthly Technical Progress Review) (U.S.)

Nucl. Sci. Appl., Ser. B
Nuclear Science and Applications, Series B (Pakistan)

Nucl. Sci. Eng.
Nuclear Science and Engineering (U.S.)

Nucl. Sci. J. (Taiwan)
Nuclear Science Journal (Taiwan) (Ho Tsu K'o Hsueh) (China)

Nucl. Technol.
Nuclear Technology (U. S.)
Supersedes Nuclear Applications and Technology

Nukl. Energ.
Nuklearna Energija (Yugoslavia)

Nukleonika
Nukleonika (Poland)

Nunt. Radiol.
Nuntius Radiologicus (Italy)

Nuovi Ann. Ig. Microbiol.
Nuovi Annali d'Igiene e Microbiologia (Italy)

Nuovo Cim., A
Nuovo Cimento, Il, A (Italy)

Nuovo Cim., B
Nuovo Cimento, Il, B (Italy)

N. Y. State J. Med.
New York State Journal of Medicine (U.S.)

N. Y. Times Mag.
New York Times Magazine (U.S.)

N. Z. J. Sci.
New Zealand Journal of Science (New Zealand)

O

Oak Ridge Nat. Lab. Rev.
Oak Ridge National Laboratory Review (U.S.)

Obstet. Gynecol.
Obstetrics and Gynecology (U.S.)

Occup. Health Nurs.
Occupational Health Nursing (U. S.)

Ocean Eng.
Ocean Engineering (U.S.)

Odontol. Revy
Odontologisk Revy (Sweden)

Odontol. Tidskr.
Odontologisk Tidskrift (Sweden)

OECD (Organ. Econ. Coop. Develop.) Observ.
OECD (Organization for Economic Cooperation and Development) Observer (France)

Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.
Oesterreichische Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse, Anzeiger (Austria)

Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II
Oesterreichische Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse, Sitzungsberichte, Abteilung II (Austria)

Oesterr. Bot. Z.
Oesterreichische Botanische Zeitschrift (Austria)

Ohio Rep.
Ohio Report (U.S.)

Ohm (Elec. Mag.)
Ohm (The Electrical Magazine Ohm) (Japan)

Oikos
Oikos, Acta Oecologica Scandinavica (Denmark)

Oita-ken Onsen Chosa Kenkyu-kai Hokoku
Oita-ken Onsen Chosa Kenkyu-kai Hokoku (Japan)

Okayama Daigaku Nogabuku Gakujutsu Hokoku
Okayama Daigaku Nogabuku Gakujutsu Hokoku (Scientific Reports of the Faculty of Agriculture, Okayama University) (Japan)

Oncology
Oncology (Formerly Oncologia) (Switzerland)

Oncol. Radiol.
Oncologia si Radiologia (Romania)

Onde Elec.
Onde Electrique, L (France)

Onken Kiyo
Onken Kiyo (The Bulletin of the Institute of Balneotherapeutics Kyushu University) (Japan)

Onsen Kogakkaishi
Onsen Kogakkaishi (Journal of the Society of Engineers for Mineral Springs, Japan) (Japan)

Ont. Hydro Res. Quart.
Ontario Hydro Research Quarterly (Canada)
Supersedes Ontario Hydro Research News

Opt. Commun.
Optics Communications (Netherlands)

Optik
Optik. Zeitschrift fuer das Gesamte Gebeit der Licht-und Elektronenoptik (West Germany)

Opt. Spectra
Optical Spectra (U.S.)

Opt. Spectrosc. (USSR) (Engl. Transl.)
Optics and Spectroscopy (USSR) (English Translation of Optika i Spektroskopiya) (U.S.)

Oral Surg., Oral Med., Oral Pathol.
Oral Surgery, Oral Medicine, Oral Pathology (U.S.)

Ortop., Travmatol. Prot.
Ortopediya, Travmatologiya i Protezirovanie (U.S.S.R.)

Orv. Hetil.
Orvosi Hetilap (Hungary)

Osaka Kogyo Gijutsu Shikenjo Kiho
Osaka Kogyo Gijutsu Shikenjo Kiho (Bulletin of the Government Industrial Research Inst., Osaka) (Japan)

Osp. Ital. Chir.
Ospedali d'Italia Chirurgia (Italy)

Osp. Magg.
Ospedale Maggiore (Italy)

Otomeshon
Otomeshon (Automation) (Japan)

Oxidation Metals
Oxidation of Metals (U. S.)

Oyo Butsuri
Oyo Butsuri (Journal of Applied Physics) (Japan)

Oyo Rikigaku Kenkyusho Shoho
Oyo Rikigaku Kenkyusho Shoho (Bulletin of the Research Inst. for Applied Mechanics, Kyushu University) (Japan)

P

Pap. Puu
Paperi Ja Puu (Finland)

Parasitology
Parasitology (England)

Particle Accel.
Particle Accelerators (Scotland)

Pathol. Eur.
Pathologia Europaea (Belgium)

Pathology
Pathology (Australia)

Patol. Fiziol. Eksp. Ter.
Patologicheskaya Fiziologiya i Eksperimentalnaya Terapiya (U.S.S.R.)

Patol. Pol.
Patologia Polska (Poland)

Pediatrics
Pediatrics (U.S.)

Pediatrie
Pediatrie (France)

Pepinieristes, Hort., Maraichers
Pepinieristes, Horticulteurs, Maraichers (France)

Perfum. Essent. Oil Rec.
Perfumery and Essential Oil Record (England)

Period. Polytech. Chem. Eng.
Periodica Polytechnica. Chemical Engineering. Chemische Ingenieurwesen (Hungary)

Period. Polytech., Mech. Eng.
Periodica Polytechnica, Mechanical Engineering (Hungary)
Supersedes Periodica Polytechnica, Engineering

Petrol. Chem. (USSR) (Engl. Transl.)
Petroleum Chemistry (USSR) (English Translation of Neftekhimiya) (U.S.)

Petrol Gaze
Petrol si Gaze (Romania)

Pharmazie
Pharmazie, Die (West Germany)

Philips Res. Rep.
Philips Research Reports (Netherlands)

Philips Tech. Rev.
Philips Technical Review (Netherlands)

Phil. Mag.
Philosophical Magazine, The (England)

Phil. Trans. Roy. Soc. London, Ser. A
Philosophical Transactions of the Royal Society of London, Series A (England)

Photochem. Photobiol.
Photochemistry and Photobiology (England)

Photophysiol. Curr. Top.
Photophysiology. Current Topics (U.S.)

Phys. Bl.
Physikalische Blaetter (West Germany)

Phys. Bull. (London)
Physics Bulletin (London) (England)

Phys. Chem. Glasses
Physics and Chemistry of Glasses (England)

Phys. Chem. Liquids
Physics And Chemistry of Liquids (England)

Phys. Educ.
Physics Education (England)

Phys. Fluids
Physics of Fluids, The (U.S.)

Physica
Physica (Netherlands)

Physiol. Behav.
Physiology and Behavior (England)

Physiol. Bohemoslov.
Physiologia Bohemoslovaca (Czechoslovakia)

Physiol. Plant.
Physiologia Plantarum (Denmark)

Physiol. Veg.
Physiologie Vegetale (France)
Absorbed Ann. Physiol. Veg.

Phys. Kondens. Mater.
Physik der Kondensierten Materie (West Germany)

Phys. Lett., A
Physics Letters, (Section) A (Netherlands)

Phys. Lett., B
Physics Letters, (Section) B (Netherlands)

Phys. Med. Biol.
Physics in Medicine and Biology (England)

Phys. Metals Metallogr. (USSR) (Engl. Transl.)
Physics of Metals and Metallography, The (USSR) (English Translation of Fizika Metallov i Metallovadeniya) (England)

Phys. Norv.
Physica Norvegica (Norway)

Phys. Rep.
Physics Reports. A Review Section of Physics Letters (Section C) (Netherlands)

Phys. Rev.
Physical Review, The (U.S.)
Divided intc Sections A, B, C, and D, Beginning Jan. 1970

Phys. Rev., A
Physical Review, The, A. General Physics (U. S.)

Phys. Rev., B
Physical Review, The, B. Solid State (U. S.)

Phys. Rev., C
Physical Review, The, C. Nuclear Physics (U. S.)

Phys. Rev., D
Physical Review, The, D. Particles and Fields (U. S.)

Phys. Rev. Lett.
Physical Review Letters (U.S.)

Phys. Scr.
Physica Scripta (Sweden)
Supersedes Arkiv for Fysik

Phys. Sintering
Physics of Sintering (Yugoslavia)

Phys. Status Solidi
Physica Status Sclidi (East Germany)
Superseded by Physica Status Solidi (a) and (b)

Phys. Status Sclidi (a)
Physica Status Solidi (a). Applied Research (East Germany)
Supersedes in part Physica Status Solidi

Phys. Status Solidi (b)
Physica Status Solidi (b). Basic Research (East Germany)
Suprsedes in part Physica Status Solidi

Phys. Today
Physics Today (U.S.)

Phys. Unserer Zeit
Physik in Unserer Zeit (West Germany)

Phytcchemistry
Phytochemistry (England - U.S.)

Planet. Space Sci.
Planetary and Space Science (England)

Planta
Planta (West Germany)

Plant Physiol.
Plant Physiology (U.S.)

Plasma Phys.
Plasma Physics (Formerly Journal of Nuclear Energy, Part C. Plasma Physics-Accelerators-Thermonuclear Research) (England)

Plast. Massy
Plasticheskie Massy (U.S.S.R.)
Issued in English Translation as Soviet Plastics

Plast. Reconstr. Surg.
Plastic and Reconstructive Surgery and the Transplantation Bulletin (U.S.)

Platinum Metals Rev.
Platinum Metals Review (England)

Pokrcky Praskove Met. VUPM
Pokroky Praskove Metalurgie VUPM (Vyzkumny Ustav pro Praskovou Metalurgii) (Czechoslovakia)

Polim. Tworzywa
Polimery Tworzywa (Poland)

Politecnica (Quito)
Politecnica (Quito) (Ecuador)

Pol. Med. J.
Polish Medical Journal (Translation of Articles, from Various Medical Journals) (Poland)

Pol'nohospodarstvo
Pol'nohospodarstvo (Czechoslovakia)

Pol. Przegl. Radiol. Med. Nukl.
Polski Przeglad Radiologii i Medycyny Nuklearnej (Poland)
Issued in English Translation as Polish Review of Radiology and Nuclear Medicine

Pol. Tyg. Lek.
Polski Tygodnik Lekarski (Poland)

Polym. Eng. Sci.
Polymer Engineering and Science (U.S.)

Polymer
Polymer (England)

Ponpu Kogaku
Ponpu Kogaku (Pump Engineering) (Japan)

Porosh. Met., Akad. Nauk Ukr. SSR
Poroshkovaya Metallurgiya, Akademiya Nauk Ukrainskoi SSR (Ukrainian S.S.R.)
For English Translation see Soviet Powder Metallurgy and Metal Ceramics

Port. Phys.
Portugaliae Physica (Portugal)

Postepy Astron.
Postepy Astronomii (Poland)

Postepy Astronaut.
Postepy Astronautyki (Poland)

Postepy Fiz.
Postepy Fizyki (Poland)

Postepy Hig. Med. Dosw.
Postepy Higieny i Medycyny Doswiadczalnej (Poland)

Poultry Sci.
Poultry Science (U.S.)

Powder Met.
Powder Metallurgy (England)

Powder Met. Int.
Powder Metallurgy International (West Germany)

Power
Power with which are Consolidated Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer, and Operating Engineer (U.S.)

Power Eng.
Power Engineering (U.S.)

Prac. Lek.
Pracovni Lekarstvi (Czechoslovakia)

Prakt. Lek.
Prakticky Lekar (Czechoslovakia)

Prakt. Metallog.
Praktische Metallographie (West Germany)

Pr. Cent. Inst. Ochrony Pracy
Prace Centralnego Instytutu Ochrony Pracy (Poland)

Precis. Metal
Precison Metal (Formerly Precision Metal Molding) (U.S.)

Prib. Tekh. Eksp.
Pribory i Tekhnika Eksperimenta (U.S.S.R.)
For English Translation see Instruments and Experimental Techniques (USSR)

Prikl. Mat. Mekh.
Prikladnaya Matematika i Mekhanika (U.S.S.R.)
Issued in English Translation as Journal of Applied Mathematics and Mechanics (USSR)

Pr. Inst. Hutn.
Prace Instytutow Hutniczych (Poland)

Pr. Inst. Masz. Przeply.
Prace Instytutu Maszyn Przeplywowych (Poland)

Pr. Inst. Mech. Precyz.
Prace Instytutu Mechaniki Precyzyjnej (Poland)

Pr. Inst. Odlew., Zesz. Specjalne
Prace Instytutu Odlewnictwa, Zeszyty Specjalne (Poland)

Probl. Actuels Oto-Rhino-Laryngol.
Problemes Actuels d'Oto-Rhino-Laryngologie (France)

Probl. Endokrinol.
Problemy Endokrinologii (Formerly Problemy Endokrinologii i Gormonoterapii) (U.S.S.R.)

Probl. Gematol. Pereliv. Krovi
Problemy Gematologii i Perelivaniya Krovi (U.S.S.R.) Issued in English Translation as Problems of Hematology and Blood Transfusion (USSR)

Probl. Prochnosti
Problemy Prochnosti (U.S.S.R.)

Proc. Amer. Ass. Cancer Res.
Proceedings of the American Association for Cancer Research (U.S.)

Proc. Amer. Power Conf.
Proceedings of the American Power Conference (U.S.)

Proc. Amer. Soc. Hort. Sci.
Proceedings of the American Society for Horticultural Science (U.S.)
Superseded by J. Amer. Soc. Hort. Sci.

Proc. Astron. Soc. Aust.
Proceedings of the Astronomical Society of Australia (Australia)

Proc. Brit. Ceram. Soc.
Proceedings of the British Ceramic Society (England)

Proc. Cambridge Phil. Soc.
Proceedings of the Cambridge Philosophical Society (England)

Process Biochem.
Process Biochemistry (England)

Proc. Fac. Sci. Tokai Univ.
Proceedings of the Faculty of Science of Tokai University (Japan)

Proc. IEEE (Inst. Elec. Electron. Eng.)
Proceedings of the IEEE (Institute of Electrical and Electronics Engineers) (Formerly Proceedings of the Institute of Radio Engineers) (U.S.)

Proc. Indiana Acad. Sci.
Proceedings of the Indiana Academy of Science (U.S.)

Proc. Indian Acad. Sci., Sect. A
Proceedings of the Indian Academy of Sciences, Section A (India)

Proc. Indian Nat. Sci. Acad., Part A
Proceedings of the Indian National Science Academy, Part A. Physical Sciences (Formerly Proceedings of the National Institute of Sciences of India, Part A) (India)

Proc. Indian Nat. Sci. Acad., Part B
Proceedings of the Indian National Science Academy, Part B. Biological Sciences (Formerly Proceedings of the National Institute of Sciences of India, Part B) (India)

Proc. Inst. Civil Eng. (London)
Proceedings of the Institution of Civil Engineers (London) (England)

Proc. Inst. Elec. Eng. (London)
Proceedings of the Institution of Electrical Engineers, The (London) (England)

Proc. Inst. Mech. Eng. (London)
Proceedings of the Institution of Mechanical Engineers (London) (England)

Proc. Int. Seed Test. Ass.
Proceedings of the International Seed Testing Association (Netherlands)

Proc. Jap. Congr. Mater. Res.
Proceedings of the Japan Congress on Materials Research (Japan)

Proc. Nat. Acad. Sci. U. S. A.
Proceedings of the National Academy of Sciences of the United States of America (U.S.)

Proc. Res. Inst. Nucl. Med. Biol.
Proceedings of Research Institute for Nuclear Medicine and Biology (Japan)

Proc. Roy. Aust. Chem. Inst.
Proceedings of The Royal Australian Chemical Institute (Australia)

Proc. Roy. Irish Acad., Sect. A
Proceedings of the Royal Irish Academy, Section A (Ireland)

Proc. Roy. Soc. (London), Ser. A
Proceedings of the Royal Society (London), Series A (England)

Proc. Roy. Soc. (London), Ser. B
Proceedings of the Royal Society (London), Series B (England)

Proc. Roy. Soc. Med.
Proceedings of the Royal Society of Medicine (England)

Proc. Roy. Soc. Med., Suppl.
Proceedings of the Royal Society of Medicine, Supplement (England)

Proc. Soc. Anal. Chem.
Proceedings of the Society for Analytical Chemistry (England)

Proc. Soc. Exp. Biol. Med.
Proceedings of the Society for Experimental Biology and Medicine (U.S.)

Progr. High Temp. Phys. Chem.
Progress in High Temperature Physics and Chemistry (England)

Progr. Med. Virol.
Progress in Medical Virology (Switzerland)

Progr. Nucl. Phys.
Progress in Nuclear Physics (England)

Progr. Theor. Phys. (Kyoto)
Progress of Theoretical Physics (Kyoto) (Japan)

Progr. Theor. Phys. (Kyoto), Suppl.
Progress of Theoretical Physics (Kyoto), Supplement (Japan)

Prot. Civ. Secur. Ind.
Protection Civile et Securite Industrielle (France)

Prum. Potravin
Prumysl Potravin (Czechoslovakia)

Przegl. Geol.
Przeglad Geologiczny (Poland)

Przegl. Lek.
Przeglad Lekarski (Poland)

Przem. Chem.
Przemysl Chemiczny (Poland)

Przem. Spozyw.
Przemysl Spozywczy (Poland)

PTB Mitt.
PTB Mitteilungen. Amts- und Mitteilungsblatt der Physikalisch-Technischen Bundesanstalt (West Germany)

Publ. Astron. Soc. Jap.
Publications of the Astronomical Society of Japan (Japan)

Publ. Astron. Soc. Pac.
Publications of the Astronomical Society of the Pacific (U.S.)

Pub. Util. Fortn.
Public Utilities Fortnightly (U.S.)

Punjab Med. J.
Punjab Medical Journal (India)

Punjab Univ. J. Math.
Punjab University Journal of Mathematics, The (Pakistan)

Purasuchikku Materiaru
Purasuchikku Materiaru (Plastic Materials) (Japan)

Pure Appl. Chem.
Pure and Applied Chemistry (The Official Journal of the International Union of Pure and Applied Chemistry) (England)

Pure Appl. Geophys.
Pure and Applied Geophysics (Formerly Geofisica Pura e Applicata) (Switzerland)

Q

Quad. Nutr.
Quaderni della Nutrizione (Italy)

Quad. Radiol.
Quaderni di Radiologia (Italy)

Quart. J. Mech. Appl. Math.
Quarterly Journal of Mechanics and Applied Mathematics (England)

Quart. J. Med.
Quarterly Journal of Medicine, The (England)

Quart. J. Roy. Astron. Soc.
Quarterly Journal of the Royal Astronomical Society, The (England)

Queensland Govt. Mining J.
Queensland Government Mining Journal (Australia)

R

Radex Rundsch.
Radex Rundschau (Austria)

Radiat. Bot.
Radiation Botany (England)

Radiat. Eff.
Radiation Effects (England)

Radiat. Res.
Radiation Research (U.S.)

Radiat. Res. Rev.
Radiation Research Reviews (Netherlands)

Radiaz. Alta Energ.
Radiazioni di Alta Energia (Italy)

Radioact. Sea
Radioactivity in the Sea (Austria)

Radiobiologiya
Radiobiologiya (U.S.S.R.)
Issued in English Translation as Radiobiology (USSR)

Radiobiol. Radiother. Fis Med.
Radiobiologia, Radioterapia e Fisica Medica (Formerly Radioterapia, Radiobiologia e Fisica Medica) (Italy)

Radiobiol.-Radiother.
Radiobiologia-Radiotherapie (East Germany)

Radiochem. Radioanal. Lett.
Radiochemical and Radioanalytical Letters (Switzerland - Hungary)

Radiochim. Acta
Radiochimica Acta (West Germany)

Radio Eng. Electron. Phys. (USSR) (Engl. Transl.)
Radio Engineering and Electronic Physics (USSR) (English Translation of Radiotekhnika i Elektronika) (U.S.)

Radiographer
Radiographer (Australia)

Radiography
Radiography (England)

Radioisotopes (Tokyo)
Radioisotopes (Tokyo) (Japan)

Radioisotopy
Radioisotopy (Czechoslovakia)

Radiokhimiya
Radiokhimiya (U.S.S.R.)
Issued in English Translation as Soviet Radiochemistry

Radiol. Clin. Biol.
Radiologia Clinica et Biologica (Formerly Radiologia Clinica) (Switzerland)

Radiol. Clin. N. Amer.
Radiologic Clinics of North America (U. S.)

Radiol. Diagn.
Radiologia Diagnostica (East Germany)

Radiol. Health Data Rep.
Radiological Health Data and Reports (Formerly Radiological Health Data) (U.S.)

Radiol. Med.
Radiologia Medica, La (Italy)

Radiologe
Radiologe (West Germany)

Radiology
Radiology (U.S.)

Radiol. Technol.
Radiologic Technology (Formerly X-Ray Technician) (U.S.)

Radioprotection
Radioprotection. Bulletin de la Societe Francaise de Radioprotection (France)

Radio Sci.
Radio Science (Formerly Journal of Research of the National Bureau of Standards, D) (U.S.)

Radiotekh. Elektron.
Radiotekhnika i Elektronika (U.S.S.R.)
Issued in English Translation as Radio Engineering and Electronic Physics (USSR)

Rame
Rame (Italy)

R and D, Kobe Seiko Giho
R and D, Kobe Seiko Giho (Japan)
Supersedes Kobe Seiko Giho

Rass. Chim.
Rassegna Chimica (Italy)

Raumfahrtforschung
Raumfahrtforschung (Formerly Raketentechnik und Raumfahrtforschung) (West Germany)

Razved. Geofiz.
Razvedochnaya Geofizika (U.S.S.R.)

Razved. Okhr. Nedr
Razvedka i Okhrana Nedr (U.S.S.R.)

RCA Rev.
RCA Review (U.S.)

RCN (Reactor Cent. Ned.) Meded.
RCN (Reactor Centrum Nederland) Mededeling (Netherlands)

Reactor Technol.
Reactor Technology. A Quarterly Technical Progress Review (Formerly Reactor and Fuel-Processing Technology) (U.S.)

Recherche (Paris)
Recherche, La (Paris) (France)
Supersedes Atomes (Paris)

Rec. Trav. Chim.
Recueil des Travaux Chimiques des Pays-Bas (Netherlands)

Refract. Mater.
Refractory Materials (U.S.)

Refractories (USSR) (Engl. Transl.)
Refractories (USSR) (English Translation of Ogneupory) (U.S.)

Rend. Ist. Lombardo Sci. Lett., A
Rendiconti dell'Istituto Lombardo di Scienze e Lettere, A Scienze Matematiche, Fisiche, Chimiche e Geologiche (Italy)

Rend. Scu. Int. Fis. Enrico Fermi
Rendiconti della Scuola Internazionale di Fisica Enrico Fermi (Italy)

Rend. Semin. Mat. Fis. Milano
Rendiconti del Seminario Matematico e Fisico di Milano (Italy)

Rentgenol. Radiol.
Rentgenologiya i Radiologiya (Bulgaria)

Rep. Ionosphere Space Res. Jap.
Report of Ionosphere and Space Research in Japan (Japan)

Rep. Progr. Phys.
Reports on Progress in Physics (England)

Rep. Res. Lab. Kirin Brewery Co., Ltd.
Report of the Research Laboratories of Kirin Brewery Co., Ltd. (Japan)

Res./Develop.
Research/Development (U.S.)

RES, J. Reticuloendothel. Soc.
RES, Journal of the Reticuloendothelial Society (U.S.)

Res. Vet. Sci.
Research in Veterinary Science (England)

Rev. Agroquim. Tecnol. Aliment.
Revista de Agroquimica y Tecnologia de Alimentos (Spain)

Rev. Biol. Med. Nucl.
Revista de Biologia y Medicina Nuclear (Uruguay)

Rev. Brasil. Med.
Revista Brasileira de Medicina (Brazil)

Rev. Brasil. Tecncl.
Revista Brasilerira de Tecnologia (Brazil)

Rev. Chim. (Bucharest)
Revista de Chimie (Bucharest) (Romania)

Rev. Chim. Miner.
Revue de Chimie Minerale (France)

Rev. Corps Sante Armees
Revue des Corps de Sante des Armees (France)

Rev. Ecuator. Hig. Med. Trop.
Revista Ecuatoriana de Higiene y Medicina Tropical (Ecuador)

Rev. Espan. Fisiol.
Revista Espanola de Fisiologia (Spain)

Rev. Eur. Etud. Clin. Biol.
Revue Europeenne d'Etudes Cliniques et Biologiques (Formerly Revue Francaise d'Etudes Cliniques et Biologiques) (France)

Rev. Fr. Energ.
Revue Francaise de l'Energie (France)

Rev. Fr. Etud. Clin. Biol.
Revue Francaise d'Etudes Cliniques et Biologiques (France)
Changed to Revue Europeenne d'Etudes Cliniques et Biologiques

Rev. Gen. Elec.
Revue Generale de l'Electricite (France)

Rev. Gen. Froid
Revue Generale du Froid (France)

Rev. Geogr. Phys. Geol. Dyn.
Revue de Geographie Physique et de Geologie Dynamique (France)

Rev. Geophys. Space Phys.
Reviews of Geophysics and Space Physics (U. S.)
Supersedes Reviews of Geophysics

Rev. Hort. Viticult.
Revista de Horticultura si Viticultura (Romania)

Rev. Hyg. Med. Soc.
Revue d'Hygiene et de Medecine Sociale (France)

Rev. Ind. Minerale
Revue de l'Industrie Minerale (France)

Rev. Inst. Fr. Petrole Ann. Combust. Liquides
Revue de l'Institut Francais du Petrole et Annales des Combustions Liquides (France)

Rev. Inst. Pasteur Lyon
Revue de l'Institut Pasteur de Lyon (France)

Rev. Int. Hautes Temp. Refract.
Revue Internaticnale des Hautes Temperatures et des Refractaires (Formerly Revue des Hautes Temperatures et des Refractaires) (France)

Rev. Med. (Tirgu-Mures)
Revista Medicala (Tirgu-Mures) (Romania)

Rev. Med. Vet. (Toulouse)
Revue de Medecine Veterinaire (Toulouse) (France)

Rev. Mex. Fis.
Revista Mexicana de Fisica (Mexico)

Rev. Mex. Fis., Supl. Fis. Apl.
Revista Mexicana de Fisica, Suplemento de Fisica Aplicada (Mexico)

Rev. Mex. Fis., Supl. Reactor
Revista Mexicana de Fisica, Suplemento del Reactor (Mexico)

Rev. Minelor (Bucharest)
Revista Minelor (Bucharest) (Romania)

Rev. Mod. Phys.
Reviews of Modern Physics (U.S.)

Rev. Phys. Appl.
Revue de Physique Appliquee (Supplement au Journal de Physique) (France)

Rev. Port. Quim. (Lisbon)
Revista Portuguesa de Quimica (Lisbon) (Portugal)

Rev. Pure Appl. Chem.
Reviews of Pure and Applied Chemistry (Australia)

Rev. Roum. Biochim.
Revue Roumaine de Biochimie (Romania)

Rev. Roum. Biol., Ser. Zool.
Revue Roumaine de Biologie, Serie Zoologie (Supersedes in Part Revue de Biologie, Academie de la Republique Populaire Roumaine) (Romania)

Rev. Roum. Chim.
Revue Roumaine de Chimie (Continuation of Revue de Chimie, Academie de la Republique Populaire Roumaine) (Romania)

Rev. Roum. Geol., Geophys. Geogr., Ser. Geol.
Revue Roumaine de Geologie, Geophysique et Geographie, Serie de Geologie (Romania)

Rev. Roum. Math. Pures Appl.
Revue Roumaine de Mathematiques Pures et Appliquees (Romania)

Rev. Roum. Phys.
Revue Roumaine de Physique (Romania)

Rev. Roum. Physiol.
Revue Roumaine de Physiologie (Romania)

Rev. Roum. Sci. Tech., Ser. Mecan. Appl.
Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee (Romania)

Rev. Sci. Instrum.
Review of Scientific Instruments, The (U.S.)

Rev. Soc. Cient. Paraguay
Revista de la Sociedad Cientifica del Paraguay (Paraguay)

Rev. Tech. Thomson-CSF
Revue Technique Thomson-CSF (Supersedes Annales de Radioelectricite and the Revue Technique Thomson-Houston) (France)

Ric. Sci.
Ricerca Scientifica, La (Supersedes Ricerca Scientifica, La. Part 2: Rendiconti, Sezione A, Abiologica and Sezione B, Biologica) (Italy)

Rikagaku Kenkyusho Hokoku
Rikagaku Kenkyusho Hokoku (Reports of the Institute of Physical and Chemical Research) (Japan)

Rinsho Ganka
Rinsho Ganka (Japanese Journal of Clinical Ophthalmology) (Japan)

Rinsho Hoshasen
Rinsho Hoshasen (Japanese Journal of Clinical Radiology) (Japan)

Riv. Biol.
Rivista di Biologia (Pubblicata a Cura dell'Istituto di Biologia Generale dell'Universita di Perugia) (Italy)

Riv. Nuovo Cim.
Rivista del Nuovo Cimento (Italy)
Supersedes Supplemento al Nuovo Cimento

Riv. Ostet. Ginecol.
Rivista di Ostetricia e Ginecologia (Italy)

Riv. Patol. Clin. Sper.
Rivista di Patologia Clinica e Sperimentale (Italy)

Rocz. Akad. Med. Bialymstoku
Roczniki Akademii Medycznej im. Juliana Marchlewskiego w Bialymstoku (Poland)

Rocz. Chem.
Roczniki Chemii (Poland)

Rocz. Glebozn.
Roczniki Gleboznawcze (Poland)

Rocz. Nauk Roln., Ser. B
Roczniki Nauk Rolniczych, Seria B. Zootechniczna (Poland)

Rocz. Panstw. Zakl. Hig.
Roczniki Panstwowego Zakladu Higieny (Poland)

Roentgen Bl.
Roentgen Blaetter (West Germany)

Roentgenpraxis
Roentgenpraxis (West Germany)

Rostlinna Vyroba
Rostlinna Vyroba (Czechoslovakia)

Rozhl. Chir.
Rozhledy v Chirurgii (Czechoslovakia)

Rubber Age (N.Y.)
Rubber Age, The (New York) (U.S.)

Rudodobiv Met. (Sofia)
Rudodobiv i Metalurgiya (Sofia) (Bulgaria)

Rudy (Prague)
Rudy (Prague) (Czechoslovakia)

Rudy Metale Niezelaz.
Rudy i Metale Niezelazne (Poland)

Russ. J. Phys. Chem. (Engl. Transl.)
Russian Journal of Physical Chemistry (English Translation of Zhurnal Fizicheskoi Khimii) (England)

Ryb. Khoz.
Rybnoe Khozyaistvo (U.S.S.R.)

S

Sabouraudia
Sabouraudia (England)

SAE (Soc. Autcmot. Eng.) J.
SAE (Society of Automotive Engineers) Journal (U.S.)
Superseded by Automat. Eng.

S. Afr. J. Sci.
South African Journal of Science (South Africa)

S. Afr. Mech. Eng.
South African Mechanical Engineer, The (South Africa)

S. Afr. Med. J.
South African Medical Journal (South Africa)

SAMPE J.
SAMPE (Society of Aerospace Material and Process Engineers) Journal (U.S.)

SAMPE Quart.
SAMPE Quarterly (U.S.)

Sanfujinka No Sekai
Sanfujinka No Sekai (The World of Obstetrics and Gynecology) (Japan)

Sanfujinka No Shimpo
Sanfujinka No Shimpo (Advances in Obstetrics and Gynecology) (Japan)

Sangre
Sangre (Spain)

Sangyo Kikai
Sangyo Kikai (Industrial Machinery) (Japan)

Sangyo To Denki
Sangyo To Denki (Industry and Electricity) (Japan)

Sapporo Igaku Zasshi
Sapporo Igaku Zasshi (The Sapporo Medical Journal) (Japan)

Sb. Geol. Ved, Uzita Geofyz.
Sbornik Geolcgickych Ved, Uzita Geofyzika (Czechoslovakia)

Sb. Nauch. Tr., Magnitogorsk. Gornomet. Inst.
Sbornik Nauchnykh Trudov, Magnitogorskii Gornometallurgicheskii Institut (U.S.S.R.)

Sb. Nauch. Tr., Tomsk. Inzh.-Stroit. Inst.
Sbornik Nauchnykh Trudov, Tomskii Inzhenerno-Stroitel'nyi Institut (U.S.S.R.)

Sb. Nauch. Tr., Ukr. Nauch.-Issled. Inst. Cgneuporov
Sbornik Nauchnykh Trudov, Ukrainskii Nauchno-Issledovatel'skii Institut Cgneuporov (Ukrainian S.S.R.)

Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.
Sbornik Trudov Tsentral'nogo Nauchno-Issledovatel'skogo Instituta Chernoi Metallurgii (U.S.S.R.)

Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove
Sbornik Vedeckych Praci Lekarske Fakulty Karlovy University v Hradci Kralove (Czechoslovakia)

Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.
Sbornik Vedeckych Praci Lekarske Fakulty Karlovy University v Hradci Kralove, Supplementum (Czechoslovakia)

Sb. Ved. Pr. VLVDU Hradci Kralove
Sbornik Vedeckych Praci VLVDU (Vojenskeho Lekarskeho Vyzkumneho a Doskolovaciho Ustavu) JEP v Hradci Kralove (Czechoslovakia)

Scand. J. Clin. Lab. Invest.
Scandinavian Journal of Clinical and Laboratory Investigation (Norway)

Scand. J. Gastroenterol.
Scandinavian Journal of Gastroenterology (Norway)

Scand. J. Haematol.
Scandinavian Journal of Haematology (Denmark)

Scand. J. Resp. Dis.
Scandinavian Journal of Respiratory Diseases (Formerly Acta Tuberculosea et Pneumologica Scandinavica) (Denmark)

Scand. J. Urol. Nephrol.
Scandinavian Journal of Urology and Nephrology (Sweden)

Schweissen Schneiden
Schweissen und Schneiden (West Germany)

Schweiz. Arch. Angew. Wiss. Tech.
Schweizer Archiv fuer Angewandte Wissenschaft und Technik (Switzerland)

Schweiz. Med. Wochensch.
Schweizerische Medizinische Wochenschrift (Switzerland)

Sci. Amer.
Scientific American (U.S.)

Sci. Avenir
Sciences et Avenir (France)

Sci. Ceram.
Science of Ceramics (England)

Sci. Cult. (Calcutta)
Science and Culture (Calcutta) (India)

Science
Science (U.S.)

Scientia (Milan)
Scientia (Milan) (Italy)

Sci. Ind. Spatiales
Sciences et Industries Spatiales (Switzerland)

Sci. Pap. Inst. Phys. Chem. Res. (Jap.)
Scientific Papers of the Institute of Physical and Chemical Research (Japan) (Formerly Journal of the Scientific Research Institute (Japan)) (Japan)

Sci. Progr. (Oxford)
Science Progress (Oxford) (England)

Sci. Progr. Decouverte
Science Progres Decouverte (Formerly Science Progres - La Nature) (France)

Sci. Rep. Kyoto Prefect. Univ. (Natur. Sci., Living Sci., Welfare Sci.)
Scientific Reports of the Kyoto Prefectural University (Natural Science, Living Science, and Welfare Science), The (Japan)

Sci. Rep. Tohcku Univ., Third Ser.
Science Reports of the Tohoku University, Third Series. Mineralogy, Petrology and Economic Geology (Japan)

Sci. Rep. Tohoku Univ., Fifth Ser.
Science Reports of the Tohoku University, Fifth Series (Japan)

Scr. Met.
Scripta Metallurgica (U.S.)

Search
Search. Science, Technology and Society (Australia)
Supersedes Australian Journal of Science

Securitas
Securitas (Italy)

Seibutsu Kagaku
Seibutsu Kagaku (Biological Science) (Japan)

Seisan Gijutsu
Seisan Gijutsu (Production Technique) (Japan)

Seisan Kenkyu
Seisan Kenkyu (Monthly Journal of the Institute of Industrial Science, University of Tokyo) (Japan)

Sekiyu To Sekiyu Kagaku
Sekiyu To Sekiyu Kagaku (Petroleum and Petrochemicals) (Japan)

Selek. Semenovod.
Selektsiya i Semenovodstvo (U.S.S.R.)

Sel'skokhoz. Biol.
Sel'skokhozyaistvennaya Biologiya (Formerly Agrobiologiya) (U.S.S.R.)

Semento Kogyo
Semento Kogyo (Cement Industry) (Japan)

Semento Konkurito
Semento Konkurito (Cement and Concrete) (Japan)

Sem. Hop. Paris
Semaine des Hopitaux de Paris, La (France)

Semin. Nucl. Med.
Seminars in Nuclear Medicine (U.S.)

Senpaku
Senpaku (Ship) (Japan)

Sen'i Gakkaishi
Sen'i Gakkaishi (Journal of the Society of Fiber Science and Technology, Japan) (Japan)

Seni Kobunshi Zairyo Kenkyusho Kenkyu Hokoku
Seni Kobunshi Zairyo Kenkyusho Kenkyu Hokoku (Japan)

Senpaku Gijutsu Kenkyujo Hokoku
Senpaku Gijutsu Kenkyujo Hokoku (Report of Ship Research Institute) (Japan)

Separ. Sci.
Separation Science (U.S.)

Seramikkusu
Seramikkusu (Ceramics) (Japan)

Shigen Gijutsu Shikenjo Hokoku
Shigen Gijutsu Shikenjo Hokoku (Report of the Resources Research Institute) (Japan)

Shikai Tenbo
Shikai Tenbo (Dental Outlook) (Japan)

Shikizai Kyokaishi
Shikizai Kyokaishi (Color Materials) (Japan)

Shikoku Igaku Zasshi
Shikoku Igaku Zasshi (Shikoku Acta Medica) (Japan)

Shimadzu Hyoron
Shimadzu Hyoron (Shimadzu Review) (Japan)

Shin Kinzoku
Shin Kinzoku (New Metals and Technics) (Japan)

Shin Kinzoku Kogyo
Shin Kinzoku Kogyo (Newer Metal Industry) (Japan)

Shinku
Shinku (Journal of the Vacuum Society of Japan) (Japan)

Shinshu Igaku Zasshi
Shinshu Igaku Zasshi (The Shinshu Medical Journal) (Japan)

Shinyaku To Rinsho
Shinyaku To Rinsho (Journal of New Remedies and Clinic) (Japan)

Shitsuryo Bunseki
Shitsuryo Bunseki (Mass Spectroscopy) (Japan)

Shokuhin Eiseigaku Zasshi
Shokuhin Eiseigaku Zasshi (Journal of the Food Hygienic Society of Japan) (Japan)

Shokuhin Eisei Kenkyu
Shokuhin Eisei Kenkyu (Food Hygiene Study) (Japan)

Showa Igakkai Zasshi
Showa Igakkai Zasshi (The Journal of the Showa Medical Association) (Japan)

Shoyakugaku Zasshi
Shoyakugaku Zasshi (Journal of Pharmacognosy) (Japan)

Siemens Rev.
Siemens Review (West Germany)

Siemens-Z.
Siemens-Zeitschrift (West Germany)

Silikaty
Silikaty (Czechoslovakia)

Simulation
Simulation (U.S.)

Sky Telesc.
Sky and Telescope (U.S.)

S. Med. J.
Southern Medical Journal (U.S.)

Soc. Astron. Ital., Mem.
Societa Astronomica Italiana, Memorie (Italy)

Soc. Biol.
Social Biology (U. S.)
Supersedes Eugenics Quarterly

Sogo Rinsho
Sogo Rinsho (Clinic All-round) (Japan)

Soil Sci.
Soil Science (U.S.)

Soil Sci. Soc. Amer., Proc.
Soil Science Society of America, Proceedings (U.S.)

Solar Phys.
Solar Physics (Netherlands)

Solar Syst. Res. (USSR) (Engl. Transl.)
Solar Systems Research (USSR) (English Translation of Astronomicheskii Vestnik) (U.S.)

Solid State Commun.
Solid State Communications (England-U.S.)

Solid-State Electron.
Solid-State Electronics. An International Journal (England)

Soobshch. Akad. Nauk Gruz. SSR
Soobshcheniya Akademii Nauk Gruzinskoi SSR (Georgian S.S.R.)

Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR
Soobshcheniya Byurakanskoi Observatorii, Akademiya Nauk Armyanskoi SSR (Armenian S.S.R.)

Sosei To Kako
Sosei To Kako (Journal of Japan Society for Technology of Plasticity) (Japan)

Sov. Astron. AJ (Engl. Transl.)
Soviet Astronomy-AJ (English Translation of Astronomicheskii Zhurnal) (U.S.)

Sov. Geol.
Sovetskaya Geologiya (U.S.S.R.)

Sov. J. Nondestruct. Test. (Engl. Transl.)
Soviet Journal of Nondestructive Testing (English Translation of Defektoskopiya) (U. S.)

Sov. Phys.-Cryst. (Engl. Transl.)
Soviet Physics-Crystallography (English Translation of Kristallografiya) (U.S.)

Sov. Phys.-Semicond. (Engl. Transl.)
Soviet Physics-Semiconductors (English Translation of Fizika i Tekhnika Poluprovodnikov) (U.S.)

Sov. Phys.-Solid State (Engl. Transl.)
Soviet Physics-Solid State (English Translation of Fizika Tverdogo Tela) (U.S.)

Sov. Phys.-Tech. Phys. (Engl. Transl.)
Soviet Physics-Technical Physics (English Translation of Zhurnal Tekhnicheskoi Fiziki) (U.S.)

Sov. Powder Met. Metal Ceram. (Engl. Transl.)
Soviet Powder Metallurgy and Metal Ceramics (English Translation of Poroshkovaya Metallurgiya, Akademiya Nauk Ukrainskoi SSR) (U.S.)

Sov. Zdravookhr. Kirg.
Sovetskoe Zdravcokhranenie Kirgizii (Kirghiz S.S.R.)

Spaceflight
Spaceflight (England)

Space Life Sci.
Space Life Sciences (Netherlands)

Space Sci. Rev.
Space Science Reviews (Netherlands)

SPARMO Bull.
SPARMO Bulletin. Solid Particles and Radiation Monitoring Organization (France)

Spectrochim. Acta, Part A
Spectrochimica Acta, Part A. Molecular Spectroscopy (England)

Spectrochim. Acta, Part B
Spectrochimica Acta, Part B. Atomic Spectroscopy (England)

Spectrosc. Lett.
Spectroscopy Letters (U.S.)

Sperimentale
Sperimentale, Lc Archivio di Biologia Normale e Patologica (Italy)

Sprechsaal Keram. Glas Email Silikate
Sprechsaal fuer Keramik Glas Email Silikate (West Germany)

Springer Tracts Mod. Phys.
Springer Tracts in Modern Physics. Ergebnisse der Exakten Naturwissenschaften (West Germany)

Staerke
Staerke, Die (West Germany)

Stahl Eisen
Stahl und Eisen (West Germany)

Staub
Staub (West Germany)

Steklo Keram.
Steklo i Keramika (U.S.S.R.)
Issued in English Translation as Glass and Ceramics (USSR)

Sterne Weltraum
Sterne und Weltraum (West Germany)

Stercids
Steroids. An International Journal (U.S.)

Stiinta Solului
Stiinta Solului (Romania)

Stomatologia (Bucharest)
Stomatologia (Bucharest) (Romania)

Stomatologiya
Stomatologiya (U.S.S.R.)

Stomatologiya (Sofia)
Stomatologiya (Sofia) (Yugoslavia)

Strahlenschutz Forsch. Prax.
Strahlenschutz in Forschung und Praxis (West Germany)

Strahlentherapie
Strahlentherapie (West Germany)

Strahlentherapie, Sonderbaende
Strahlentherapie, Sonderbaende (West Germany)

Strojirenstvi
Strojirenstvi (Czechoslovakia)

Stud. Appl. Math.
Studies in Applied Mathematics (Formerly Journal of Mathematics and Physics (Cambridge, Mass.)) (U.S.)

Stud. Biophys.
Studia Biophysica (East Germany)

Stud. Cercet. Astron.
Studii si Cercetari de Astronomie (Romania)

Stud. Cercet. Biochim.
Studii si Cercetari de Biochimie (Formerly Academia Republicii Populare Romine, Institutul de Biochemie, Studii si Cercetari de Biochimie) (Romania)

Stud. Cercet. Biol., Ser. Bot.
Studii si Cercetari de Biologie, Seria Botanica (Romania)

Stud. Cercet. Biol., Ser. Zool.
Studii si Cercetari de Biologie, Seria Zoologie (Romania)

Stud. Cercet. Chim.
Studii si Cercetari de Chimie (Romania)

Stud. Cercet. Energ. Electroteh.
Studii si Cercetari de Energetica si Electrotehnica (Romania)

Stud. Cercet. Fiz.
Studii si Cercetari de Fizica (Formerly Academia Republicii Populare Romine, Institutul de Fizica Atomica si Institutul de Fizica, Studii si Cercetari de Fizica) (Romania)

Stud. Cercet. Fiziol.
Studii si Cercetari de Fiziologie (Formerly Academie Republicii Populare Romine, Institutul de Fiziologie Normala si Pathologie Dr. D. Danielo-Polu, (Studii si Cercetari de Fiziologie)) (Romania)

Stud. Cercet. Geol., Geofiz., Geogr., Ser. Geofiz.
Studii si Cercetari de Geologie, Geofizica, Geografie, Seria Geofizica (Romania)

Stud. Cercet. Inframicrobiol.
Studii si Cercetari de Inframicrobiologie (Romania)

Stud. Cercet. Mec. Apl.
Studii si Cercetari de Mecanica Aplicata (Romania)

Stud. Cercet. Met.
Studii si Cercetari de Metalurgie (Romania)

Stud. Univ. Babes-Bolyai, Ser. Chem.
Studia Universitatis Babes-Bolyai, Series Chemia (Romania)

Stud. Univ. Babes-Bolyai, Ser. Phys.
Studia Universitatis Babes-Bolyai, Series Physica (Romania)
Continues in part Studia Universitatis Babes-Bolyai, Series Mathematica-Physica

Suido Kyokai Zasshi
Suido Kyokai Zasshi (Journal of Water Works Association) (Japan)

Sulzer Tech. Rev.
Sulzer Technical Review (Switzerland)

Sumitomo Elec. Rev.
Sumitomo Electric Review, The (Sumitomo Denki) (Japan)

Sumitomo Elec. Tech. Rev.
Sumitomo Electric Technical Review (Japan)

Sumitomo Kinzoku
Sumitomo Kinzoku (Sumitomo Metals) (Japan)

Sumitomo Search
Sumitomo Search (Japan)

Suomen Kem.
Suomen Kemistilehti (Finland)

Surface Sci.
Surface Science (Netherlands)

Surgery
Surgery (U.S.)

Surg. Forum
Surgical Forum, Proceedings of the Forum Sessions, Clinical Congress of the American College of Surgeons (U.S.)

Surg. Gynecol. Obstet.
Surgery, Gynecology and Obstetrics with International Abstracts of Surgery (U.S.)

Suvrem. Med.
Suvremenna Meditsina (Bulgaria)

Svar. Proizv.
Svarochnoe Proizvodstvo (U.S.S.R.)
Issued in English Translation as Welding Production (USSR)

Sv. Forfattningssamling
Svensk Forfattningssamling (Sweden)

Symp. Int. Soc. Cell Biol.
Symposia of the International Society for Cell Biology (U.S.)

T

Taikabutsu
Taikabutsu (Refractories) (Japan)

Taika Zairyo
Taika Zairyo (Refractory Material) (Japan)

Taisei Kensetsu Gijutsu Kenkyusho-Ho
Taisei Kensetsu Gijutsu Kenkyusho-Ho (Japan)

Talanta
Talanta (England)

Tandlaegebladet
Tandlaegebladet (Denmark)

Tanpakushitsu Kakusan Koso
Tanpakushitsu Kakusan Koso (Protein, Nucleic Acid, Enzyme) (Japan)

Tanso
Tanso (Carbons) (Japan)

Tech. Mitt. AEG-Telefunken
Technische Mitteilungen AEG-Telefunken (A Continuation of AEG-Mitteilungen) (West Germany)

Tech. Mitt. Krupp, Forschungsber.
Technische Mitteilungen Krupp, Forschungsberichte (West Germany)

Tech. Mitt. Krupp, Werksber.
Technische Mitteilunge Krupp, Werksberichte (West Germany)

Tech. Mod.
Technique Moderne, La (France)

Technica (Basel)
Technica (Basel) (Switzerland)

Technology (Sindri)
Technology (Sindri). Quarterly Bulletin of the Planning and Development Div., Fertilizer Corp. of India Ltd. (India)

Technol. Rep. Osaka Univ.
Technology Reports of the Osaka University (Japan)

Tech. Poszukiwan
Technika Poszukiwan (Poland)

Tech. Ueberwach.
Technische Ueberwachung (West Germany)

Tehnika (Belgrade)
Tehnika (Belgrade) (Yugoslavia)

Tekhnol. Organ. Proizvod.
Tekhnologiya i Organizatsiya Proizvodstva (Ukrainian S.S.R.)

Tekniikka
Tekniikka (Finland)
Supersedes Teknillinen Aikakuslehti

Tek. Tidskr.
Teknisk Tidskrift (Sweden)

Tek. Ukebl.
Teknisk Ukeblad (Norway)

Tellus
Tellus. A Quarterly Journal of Geophysics (Sweden)

Tenn. Farm Home Sci., Progr. Rep.
Tennessee Farm and Home Science, Progress Report (U.S.)

Tensor
Tensor (Japan)

Teor. Eksp. Khim.
Teoreticheskaya i Eksperimental'naya Khimiya (Ukrainian S.S.R.)
Issued in English Translation as Theoretical and Experimental Chemistry (USSR)

Teor. Mat. Fiz.
Teoreticheskaya i Matematicheskaya Fizika (U.S.S.R.)

Teor. Osn. Khim. Tekhnol.
Teoreticheskie Osnovy Khimicheskoi Tekhnologii (U.S.S.R.)
Issued in English translation as Theor. Found. Chem. Eng. (USSR)

Teplofiz. Vys. Temp.
Teplofizika Vysokikh Temperatur (U.S.S.R.)
Issued in English Translation as High Temperature (USSR)

Teratology
Teratology (U.S.)

Termotecnica (Milan)
Termotecnica, La (Milan) (Italy)

Tetrahedron
Tetrahedron. An International Journal of Organic Chemistry (England)

Tetrahedron Lett.
Tetrahedron Letters (England)

Tetsu To Hagane
Tetsu To Hagane (Journal of the Iron and Steel Institute) (Japan)

Tex. J. Sci.
Texas Journal of Science, The (U.S.)

Tex. Rep. Biol. Med.
Texas Reports on Biology and Medicine (U.S.)

Text. Res. J.
Textile Research Journal (U.S.)

Theor. Appl. Genet.
Theoretical and Applied Genetics (Formerly Zuechter. Genetics and Breeding Research) (West Germany)

Therapiewoche
Therapiewoche, Die (West Germany)

Thin Films
Thin Films (U.S.)

Thin Solid Films
Thin Solid Films (Netherlands)

Thorax
Thorax (England)

Tidsskr. Norske Laegforen.
Tidsskrift for den Norske Laegeforening (Norway)

Tohoku J. Exp. Med.
Tohoku Journal of Experimental Medicine, the (Japan)

Tohoku Nogyo Shikenjo Kenkyu Hokoku
Tohoku Nogyo Shikenjo Kenkyu Hokoku (Bulletin of the Tohoku National Agricultural Experiment Station) (Japan)

Tokai Daigaku Kiyo Kogakubu
Tokai Daigaku Kiyo Kogakubu (Proceedings of the Faculty of Engineering, of Tokai University (Japan)

Tokyo Daigaku Kogakubu Fuzoku Sogo Shikenjo Nenpo
Tokyo Daigaku Kogakubu Fuzoku Sogo Shikenjo Nenpo (Report of Engineering Inst., Faculty of Engineering, Tokyo University) (Japan)

Tokyo Daigaku Kogakubu Kiyo, A
Tokyo Daigaku Kogakubu Kiyo, A (Journal of the Faculty of Engineering, University of Tokyo, Series A) (Japan)

Tokyo Daigaku Uchu Koku Kenkyusho Hokoku
Tokyo Daigaku Uchu Koku Kenkyusho Hokoku (Bulletin of the Institute of Space and Aeronautical Science, University of Tokyo) (Japan)

Tokyo Igaku Zasshi
Tokyo Igaku Zasshi (The Tokyo Journal of Medical Sciences) (Japan)

Tokyo Toritsu Eisei Kenkyusho Nempo
Tokyo Toritsu Eisei Kenkyusho Nempo (Annual Report of Tokyo Metropolitan Labs. for Medical Science) (Japan)

Tongmul Hakhoe Ji
Tongmul Hakhoe Ji (Korean Journal of Zoology) (South Korea)

Tool. Prod.
Tooling and Production (U. S.)

Toshiba Rebyu
Toshiba Rebyu (Toshiba Review) (Japan)

Toshiba Rev., Int. Ed.
Toshiba Review, International Edition (Japan)

Toso To Toryo
Toso To Toryo (Finish and Paint) (Japan)

Tottori Daigaku Kyoikugakubu Kenkyu Hokoku, Shizenkagaku
Tottori Daigaku Kyoikugakubu Kenkyu Hokoku, Shizenkagaku (Journal of the Faculty of Education, Natural Science, Tottori University) (Japan)

Toxicol. Appl. Pharmacol.
Toxicology and Applied Pharmacology (U.S.)

Toxicol. Radicactive Subst. (USSR) (Engl. Transl.)
Toxicology of Radioactive Substances, The (USSR) (English Translation of Materialy po Toksikologii Radioaktivnykh Veshchestv) (England)

Trans. Amer. Acad. Ophthalmol. Oto-Laryngol.
Transactions of the American Academy of Ophthalmology and Oto-Laryngology (U.S.)

Trans. Amer. Fish. Soc.
Transactions of the American Fisheries Society (U.S.)

Trans. Amer. Foundrymen's Soc.
Transactions of the American Foundrymen's Society (U.S.)

Trans. Amer. Nucl. Soc.
Transactions of the American Nuclear Society (U.S.)

Trans. Bose Res. Inst. (Calcutta)
Transactions of the Bose Research Institute (Calcutta) (India)

Trans. Brit. Ceram. Soc.
Transactions of the British Ceramic Society Incorporating British Ceramic Abstracts (England)
Superseded by Trans. J. Brit. Ceram. Soc.

Trans. Faraday Soc.
Transactions of the Faraday Society (England)

Trans. Indian Ceram. Soc.
Tranactions of the Indian Ceramic Society (India)

Trans Indian Inst. Metals
Transactions of the Indian Instiute of Metals (India)

Trans. Inst. Metal Finish.
Transactions of the Institute of Metal Finishing (England)

Trans. Jap. Inst. Metals
Transactions of the Japan Institute of Metals (Sendai) (Japan)

Trans. Pac. Coast Oto-Ophthalmol. Soc.
Transactions of the Pacific Coast Oto-Ophthalmological Society (U.S.)

Transplantation
Transplantation (Formerly Transplantation Bulletin) (U.S.)

Transplant. Proc.
Transplantation Proceedings (U.S.)

Trans. Roy. Soc. Can.
Transactions of the Royal Society of Canada (Canada)

Trans. Soc. Advan. Electrochem. Sci. Technol.
Transaactions of the Society for Advancement of Electrochemical Science and Technology (India)

Trans. Soc. Occup. Med.
Transactions of the Society of Occupational Medicine (England)

Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR
Trudy Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Tr. Fiz. Inst., Akad. Nauk SSSR
Trudy Fizicheskogo Instituta Imeni P. N. Lebedeva, Akademiya Nauk SSSR (U.S.S.R.)
Issued in English Translation as Proceedings (Trudy) of the P. N. Lebedev Physics Institute

Tr. Gl. Geofiz. Observ.
Trudy Glavnoi Geofizicheskoi Observatorii (U.S.S.R.)

Tr., Gos. Nauch.-Issled. Proekt. Inst. Splavov Obrab. Tsvet. Metal.
Trudy, Gosudarstvennyi Nauchno-Issledovatel'skii i Proektnyi Institut Splavov i Obrabotki Tsvetnykh Metallov (U.S.S.R.)

Tr. Gruz. Politekh. Inst.
Trudy Gruzinskogo Politekhnicheskogo Instituta (Georgian S.S.R.)

Tr. Inst. Ekol. Rast. Zhivotn.
Trudy Instituta Ekologii Rastenii i Zhivotnykh (U.S.S.R.)

Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial
Trudy Instituta Elektrokhimii, Akademiya Nauk SSSR, Ural'skii Filial (U.S.S.R.)

Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Filial
Trudy Instituta Khimii, Akademiya Nauk SSSR, Ural'skii Filial (U.S.S.R.)

Tr. Inst. Met., Sverdlovsk
Trudy Instituta Metallurgii, Sverdlovsk (U.S.S.R.)

Tr. Irkutsk. Politekh. Inst.
Trudy Irkutskogo Politekhnicheskogo Instituta (U.S.S.R.)

Tr. Khim.-Met. Inst., Akad. Nauk Kaz. SSR
Trudy Khimiko-Metallurgicheskogo Instituta, Akademiya Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Tr. Kom. Anal. Khim., Akad. Nauk SSSR
Trudy Komissi po Analiticheskoi Khimii, Akademiya Nauk SSSR (U.S.S.R.)

Tr. Leningrad. Politekh. Inst.
Trudy Leningradskogo Politekhnicheskogo Instituta imeni M. I. Kalinina (U.S.S.R.

Tr. Metrol. Inst. SSSR
Trudy Metrologicheskikh Institutov SSSR (U.S.S.R.)

Tr. Morsk. Gidrofiz. Inst., Akad. Nauk Ukr. SSR
Trudy Morskogo Gidrofizicheskogo Instituta, Akademiya Nauk Ukrainskoi SSR (Ukrainian S.S.R.)

Tr., Mosk. Inst. Neftekhim. Gazov. Prom.
Trudy, Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti im. I. M. Gubkina (U.S.S.R.)

Tr. 1 (Pervogo) Mosk. Med. Inst.
Trudy 1 (Pervogo) Moskovskogo Meditsinskogo Instituta (U.S.S.R.)

Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.
Trudy Soyuznogo Nauchno-Issledovatel'skogo Instituta Priborostroeniya (U.S.S.R.)

Tr. Tallin. Politekh. Inst., Ser. A
Trudy Tallinskogo Politekhnicheskogo Instituta, Seriya A (Estonian S.S.R.)

Tr., Tsent. Nauch.-Issled. Gornorazved. Inst.
Trudy, Tsentral'nyi Nauchno-Issledovatel'skii Gornorazvedochnyi Institut (U.S.S.R.)

Tr. Univ. Druzhby Nar., Fiz.
Trudy Universiteta Druzhby Narodov, Fizika (U.S.S.R.)

Tr. Vses. Nauch.-Issled. Geol. Inst.
Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Geologicheskogo Instituta (U.S.S.R.)

Tr. Vses. Nauch.-Issled. Inst. Khim. Reaktivov
Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Khimicheskikh Reaktivov (U.S.S.R.)

Tr. Vses. Nauch.-Issled. Inst. Morsk. Ryb. Khoz. Okeanogr.
Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Morskogo Rybnogo Khozyaistva i Okeanografii (U.S.S.R.)

Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektr. Etalonov
Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Standartnykh Obraztsov i Spektral'nykh Etalonov (U.S.S.R.)

Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.
Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (U.S.S.R.)

Tschermaks Mineral. Petrogr. Mitt.
Tschermaks Mineralogische und Petrographische Mitteilungen (Austria)

Tsitol. Genet.
Tsitologiya i Genetika (Ukrainian S.S.R.)

Tsitologiya
Tsitologiya (U.S.S.R.)

Tsvetn. Metal.
Tsvetnye Metally (U.S.S.R.)
For English Translation see the Soviet Journal of Non-Ferrous Metals

Tungsten News
Tungsten News (U.S.)

U

Uchu Kagaku Gijutsu Koenkai Koenshu
Uchu Kagaku Gijutsu Koenkai Koenshu (Japan)

Uchusen Kenkyu
Uchusen Kenkyu (Studies of Cosmic Ray) (Japan)

Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk
Uchenye Zapiski Azerbaidzhanskogo Gosudarstvennogo Universiteta im. S. M. Kirova, Seriya Khimicheskikh Nauk (Azerbaidzhan S.S.R.)

Uch. Zap. Leningrad. Gos. Univ., Ser. Fiz. Nauk
Uchenye Zapiski Leningradskogo Gosudarstvennogo Universiteta, Seriya Fizicheskikh Nauk (U.S.S.R.)

Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk
Uchenye Zapiski Leningradskogo Gosudarstvennogo Ordena Lenina Universita imeni A. A. Zhdanova, Seriya Matematicheskikh Nauk (U.S.S.R.)

Uch. Zap., Perm. Gos. Univ.
Uchenye Zapiski, Permskii Gosudarstvennyi Universitet imeni A. M. Gor'kogo (U.S.S.R.)

Uch. Zap. Ural. Gos. Univ.
Uchenye Zapiski Ural'skogo Gosudarstvennogo Universiteta (U.S.S.R.)

Ugeskr. Laeger
Ugeskrift for Laeger (Denmark)

Ukr. Biokhim. Zh.
Ukrainskii Biokhimichnii Zhurnal (Ukrainian S.S.R.)

Ukr. Fiz. Zh. (Russ. Ed.)
Ukrainskii Fizicheskii Zhurnal (Russian Edition) (Ukrainian S.S.R.)

Ukr. Khim. Zh.
Ukrainskii Khimicheskii Zhurnal (Ukrainian S.S.R.)
Issued in English Translation as Soviet Progress in Chemistry

Ultrasonics
Ultrasonics (England)

Umsch. Wiss. Tech.
Umschau in Wissenschaft und Technik (West Germany)

Union Med. Can.
Union Medicale du Canada, L (Canada)

Urologe, Ausg. A
Urologe, Der, Ausgabe A (West Germany)
Supersedes in part Urologe, Der

U. S., Geol. Surv., Prof. Pap.
United States Department of the Interior, Geological Survey, Professional Paper (U.S.)

Usp. Fiz. Nauk
Uspekhi Fizicheskikh Nauk (U.S.S.R.)
Issued in English Translation as Soviet Physics- Uspekhi

Usp. Nauch. Fotogr.
Uspekhi Nauchnoi Fotografii (U.S.S.R.)

Usp. Sovrem. Biol.
Uspekhi Sovremennoi Biologii (U.S.S.R.)

Usp. Sovrem. Genet.
Uspekhi Sovremennoi Genetiki (U.S.S.R.)

Uzb. Biol. Zh.
Uzbekskii Biologicheskii Zhurnal, Akademiya Nauk Uzbekskoi SSR (Uzbek S.S.R.)

Uzb. Khim. Zh.
Uzbekskii Khimicheskii Zhurnal, Akademiya Nauk Uzbekskoi SSR (Uzbek S.S.R.)

V

Vacuum
Vacuum. The International Journal and Abstracting Service for Vacuum Research and Technology (England)

Vakuum-Tech.
Vakuum-Technik (West Germany)

VDI (Ver. Deut. Ing.) Nachr.
VDI (Verein Deutscher Ingenieure) Nachrichten (West Germany)

VDI (Ver. Deut. Ing.) Z.
VDI (Verein Deutscher Ingenieure) Zeitschrift fuer die Gesamte Technik
(Formerly VDI (Verein Deutscher Ingenieure) Zeitschrift) (West Germany)

Verh. Kon. Vlaam. Acad. Wetensch., Belg., Kl. Wetensch.
Verhandelingen van de Koninklijke Vlaamse Academie voor Wetenschappen, Letteren en Schone Kunsten van Belgie, Klasse der Wetenschappen (Belgium)

Vestn. Akad. Med. Nauk SSSR
Vestnik Akademii Meditsinskikh Nauk SSSR (U.S.S.R.)

Vestn. Akad. Nauk Kaz. SSR
Vestnik Akademii Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Vestn. Akad. Nauk SSSR
Vestnik Akademii Nauk SSSR (U.S.S.R.)

Vestn. Beloruss. Gos. Univ., Ser. 2
Vestnik Belorusskogo Gosudarstvennogo Universiteta, Seriya 2. Biologiya, Khimiya, Geologiya, Geografiya (Belorussian S.S.R.)

Vestn. Khar'kov. Politekh. Inst.
Vestnik Khar'kovskogo Politekhnicheskogo Instituta (Ukrainian S.S.R.)

Vestn. Khir.
Vestnik Khirurgii imeni I. I. Grekova (U.S.S.R.)

Vestn. Leningrad. Univ., Fiz., Khim.
Vestnik Leningradskogo Universiteta, Fizika, Khimiya (Formerly Vestnik Leningradskogo Universiteta, Seriya Fiziki i Khimii) (U.S.S.R.)

Vestn. Leningrad. Univ., Mat., Mekh., Astron.
Vestnik Leningradskogo Universiteta, Matematika, Mekhanika, Astronomiya (Formerly Vestnik Leningradskogo Universiteta, Seriya Matematiki, Mekhaniki i Astronomii) (U.S.S.R.)

Vestn. Leningrad. Univ., Ser. Biol.
Vestnik Leningradskogo Universiteta, Seriya Biologii (U.S.S.R.)

Vestn. Min. Zdrav.
Vestnik Ministerstva Zdravotnictvi (Czechoslovakia)

Vestn. Mosk. Univ., Biol. Pochvoved.
Vestnik Moskovskogo Universiteta, Biologiya, Pochvovedenie (Continues in part Vestnik Moskovskogo Universiteta, Seriya Biologii, Pochvovedeniya, Geologii, Geografii) (U.S.S.R.)

Vestn. Mosk. Univ., Ser. II. Khim.
Vestnik Moskovskogo Universiteta, Seriya II. Khimiya (Formerly a Part of Vestnik Moskovskogo Universiteta, Seriya Matematiki, Mekhaniki, Astronomii, Fiziki i Khimii) (U.S.S.R.)

Vestn. Mosk. Univ., Ser. III. Fiz. Astron.
Vestnik Moskovskogo Universiteta, Seriya III. Fizika, Astronomiya (U.S.S.R.)

Vestn. Mosk. Univ., Ser. VI, Biol. Pochvoved.
Vestnik Moskovskogo Universiteta, Seriya VI, Biologiya, Pochvovedenie (U.S.S.R.)

Vestn. Oftal'mol.
Vestnik Oftal'mologii (U.S.S.R.)

Vestn. Rentgenol. Radiol.
Vestnik Rentgenologii i Radiologii (U.S.S.R.)

Vestn. Sel'skokhoz. Nauki (Moscow)
Vestnik Sel'skokhozyaistvennoi Nauki (Moscow) (U.S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk
Vestsi Akademii Navuk BSSR, Seryya Biyalagichnykh Navuk

(Formerly Carried as Vestsi Akademii Navuk Belaruskai SSR, Seryya Biyalagichnykh Navuk) (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk
Vestsi Akademii Navuk BSSR, Seryya Fizika-Matematychnykh Navuk (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk
Vestsi Akademii Navuk BSSR, Seryya Fizika-Tekhnichnykh Navuk (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Khim. Navuk
Vestsi Akademii Navuk BSSR, Seryya Khimichnykh Navuk (Belorussian S.S.R.)

Veterinariya
Veterinariya (U.S.S.R.)

Vet. Med. (Prague)
Veterinarni Medicina (Prague) (Czechoslovakia)

Vet. Rec.
Veterinary Record, The (England)

Vide
Vide, Le, Technique-Applications (France)

Vigyan Pragati
Vigyan Pragati (India)

Vinodel. Vinograd. SSSR
Vinodelie i Vinogradarstvo SSSR (U.S.S.R.)

Virchows Arch., A
Virchows Archiv, A. Pathologische Anatomie (Formerly Archiv fuer Pathologische Anatomie und Physiologie and fuer Klinische Medizin, Virchows) (West Germany)

Virchows Arch., B
Virchows Archiv, B. Zellpathologie (Formerly Frankfurter Zeitschrift fuer Pathologie) (West Germany)

Virology
Virology (U.S.)

Visn. Akad. Nauk Ukr. RSR
Visnik Akademii Nauk Ukrains'koi RSR (Ukrainian S.S.R.)

Visn. L'viv. Derzh. Univ., Ser. Khim.
Visnik L'vivs'kogo Derzhavnogo Universitetu im. Ivana Franka, Seriya Khimichna (Ukrainian S.S.R.)

Vitalst. Zivilisationskr.
Vitalstoffe Zivilisationskrankheiten (West Germany)

Vnitr. Lek.
Vnitrni Lekarstvi (Czechoslovakia)

Vod. Hospod., B
Vodni Hospodarstvi, B (Czechoslovakia)

Voenno Med. Delo
Voenno Meditsinsko Delo (Bulgaria)

Voenno-Med. Zh.
Voenno-Meditsinskii Zhurnal (U.S.S.R.)

Vojnosanit. Pregl.
Vojnosanitetski Pregled (Yugoslavia)

Vop. Eksp. Klin. Radiol.
Voprosy Eksperimental'noi i Klinicheskoi Radiologii (Ukrainian S.S.R.)

Vop. Ikhtiol.
Voprosy Ikhtiologii (U.S.S.R.)

Vop. Kurortol., Fizioter. Lech. Fiz. Kul't.
Voprosy Kurortologii, Fizioterapii i Lechebnoi Fizicheskoi Kul'tury (U.S.S.R.)

Vop. Med. Khim.
Voprosy Meditsinskoi Khimii (U.S.S.R.)

Vop. Onkol.
Voprosy Onkologii (U.S.S.R.)

Vop. Pitan.
Voprosy Pitaniya (U.S.S.R.)

Vop. Razved. Geofiz.
Voprosy Razvedochnoi Geofiziki (U.S.S.R.)

Vop. Virusol.
Voprosy Virusologii (U.S.S.R.)

Vox Sang.
Vox Sanguinis. Journal of Blood Transfusion and Immuno-Haematology (Switzerland)

Vrach. Delo
Vrachebnoe Delo (Ukrainian S.S.R.)

Vysokomol. Soedin., Ser. A
Vysokomolekulyarnye Soedineniya, Seriya A (Continues in Part Vysokomolekulyarnye Soedineniya) (U.S.S.R.) Issued in English Translation as Polymer Science (USSR)

Vysokomol. Soedin., Ser. B
Vysokomolekulyarnye Soedineniya, Seriya B (Continues in Part Vysokomolekulyarnye Soedineniya) (U.S.S.R.)

W

Waerme
Waerme, die (West Germany)

Waerme Stoffuebertrag.
Waerme- und Stoffuebertragung (West Germany)

Waseda Daigaku Rikcgaku Kenkyusho Hokoku
Waseda Daigaku Rikogaku Kenkyusho Hokoku (Bulletin of the Scientific and Engineering Research Laboratory Waseda University) (Japan)

Wasser, Luft Betr.
Wasser, Luft und Betrieb (West Germany)

Water Res.
Water Research (Supersedes in Part Air and Water Pollution) (England)

Water Resour. Res.
Water Resources Research (U.S.)

Weather (London)
Weather (London) (England)

Weld. Design Fabr.
Welding Design and Fabrication (U.S.)

Weld. Eng.
Welding Engineer (U.S.)

Weld. J. (N.Y.)
Welding Journal, The (New York) (U.S.)

Weld. Metal. Fabr.
Welding and Metal Fabrication (Formerly Welding) (England)

Werkstatt Betr.
Werkstatt und Betrieb (West Germany)

Werkst. Korros.
Werkstoffe und Korrosion (West Germany)

West. Mach. Steel World
Western Machinery and Steel World (U.S.)

Wien. Klin. Wochenschr.
Wiener Klinische Wochenschrift (Austria)

Wilhelm Roux' Arch. Entwicklungsmech. Organismen
Wilhelm Roux' Archiv fuer Entwicklungsmechanik der Organismen (West Germany)

Wiss. Ber. AEG-Telefunken
Wissenschaftliche Berichte AEG-Telefunken (Continuation of Telefunken-Zeitung) (West Germany)

Wiss. Z. Tech. Hochsch. Chem. Leuna-Merseburg
Wissenschaftliche Zietschrift der Technischen Hochschule fuer Chemie Leuna-Merseburg (East Germany)

Wiss. Z. Tech. Hochsch. Otto von Guericke Magdeburg
Wissenschaftliche Zeitschrift der Technischen Hochschule Otto von Guericke Magdeburg (East Germany)

Wood Sci. Technol.
Wood Science and Technology (U.S.)

World Health Organ., Tech. Rep. Ser.
World Health Organization, Technical Report Series (Switzerland)

Y

Yadern. Fiz.
Yadernaya Fizika (U.S.S.R.)
Issued in English Translation as Soviet Journal of Nuclear Physics

Yonsei Med. J.
Yonsei Medical Journal (South Korea)

Yosetsu Gijutsu
Yosetsu Gijutsu (Welding Technique) (Japan)

Yosui To Haisui
Yosui To Haisui (Journal of Water and Waste) (Japan)

Yuatsu Gijutsu
Yuatsu Gijutsu (Hydraulics and Pneumatics) (Japan)

Yuki Gosei Kagaku Kyokai Shi
Yuki Gosei Kyokai Shi (Journal of the Society of Organic Synthetic Chemistry, Japan) (Japan)

Z

Zairyo
Zairyo (Journal of the Japan Society for Materials Science) (Japan)

Zairyo Kagaku
Zairyo Kagaku (Journal of the Materials Science Society of Japan) (Japan)

Z. Allg. Mikrobiol.
Zeitschrift fuer Allgemeine Mikrobiologie Morphologie, Physiologie, und Oekologie der Mikroorganismen (East Germany)

Z. Anal. Chem.
Zeitschrift fuer Analytische Chemie, Fresenius (West Germany)

Z. Angew. Entomol.
Zeitschrift fuer Angewandte Entomologie (West Germany)

Z. Angew. Geol.
Zeitschrift fuer Angewandte Geologie (East Germany)

Z. Angew. Math. Phys.
Zeitschrift fuer Angewandte Mathematik und Physik (Switzerland)

Z. Angew. Phys.
Zeitschrift fuer Angewandte Physik (West Germany)

Z. Anorg. Allg. Chem.
Zeitschrift fuer Anorganische und Allgemeine Chemie (East Germany)

Zashch. Metal.
Zashchita Metallov (U.S.S.R.)
Issued in English Translation as Protection of Metals (USSR)

Zavod. Lab.
Zavodskaya Laboratoriya (U.S.S.R.)
For English Translation see Industrial Labcratory (USSR)

Zdravookhr. Tadzh.
Zdravookhranenie Tadzhikistana (Tadzhik S.S.R.)

Zemlya Vselennaya
Zemlya i Vselennaya (U.S.S.R.)

Zentralbl. Bakteriol. Parasitenk., Abt. I
Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, Abteilung I (East Germany)

Zentralbl. Bakteriol. Parasitenk., Abt. II
Zentralblatt fuer Bakteriologie, Parasitenkunde Infektionskrankheiten und Hygiene, Abteilung II (East Germany)

Zentralbl. Gynaekol.
Zentralblatt fuer Gynaekologie (East Germany)

Zentralbl. Veterinaermed., Beih.
Zentralblatt fuer Veterinaermedizin, Beiheft (West Germany)

Z. Erzbergbau Metallhuettenw.
Zeitschrift fuer Erzbergbau und Metallhuettenwesen (West Germany)
Superseded by Erzmetall

Zesz. Nauk. Akad. Gorn.-Hutn. Krakow., Rozpr.
Zeszyty Naukowe Akademii Gorniczo-Hutniczej w Krakowie, Rozprawy (Poland)

Zesz. Nauk. Politech. Lodz., Chem. Spozyw.
Zeszyty Naukowe Politechniki Lodziej, Chemia Spozywcza (Poland)

Z. Geburtsh. Gynaekol.
Zeitschrift fuer Geburtshilfe und Gynaekologie (West Germany)

Z. Geophys.
Zeitschrift fuer Geophysik (West Germany)

Z. Gesam. Exp. Med.
Zeitschrift fuer Gesamte Experimentelle Medizin Zugleich Fortsetzung der Zeitschrift fuer Experimentelle Pathologie und Therapie (West Germany)

Zh. Anal. Khim.
Zhurnal Analiticheskoi Khimii (U.S.S.R.)
Issued in English Translation as the Journal of Analytical Chemistry of the USSR

Z. Haut- Geschlechtskr.
Zeitschrift fuer Haut- und Geschlechtskrankheiten (Germany)

Zh. Eksp. Klin. Med.
Zhurnal Eksperimentalnoi i Klinicheskoe Meditsiny (Armenian S.S.R.)

Zh. Eksp. Teor. Fiz.
Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki (U.S.S.R.)
Issued in English Translation as Soviet Physics JETP

Zh. Fiz. Khim.
Zhurnal Fizicheskoi Khimii (U.S.S.R.)
Issued in English Translation as Russian Journal of Physical Chemistry

Zh. Mikrobiol., Epidemiol. Immunobiol.
Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii (U.S.S.R.)

Zh. Nauch. Prikl. Fotogr. Kinematogr.
Zhurnal Nauchnoi i Prikladnoi Fotografii i Kinematografii (U.S.S.R.)

Zh. Neorg. Khim.
Zhurnal Neorganicheskoi Khimii (U.S.S.R.)
Issued in English Translation as Russian Journal of Inorganic Chemistry

Zh. Nevropatol. Psikhiat.
Zhurnal Nevropatologii i Psikhiatrii imeni S. S. Korsakova (U.S.S.R.)

Zh. Obshch. Biol.
Zhurnal Obshchei Biologii (U.S.S.R.)

Zh. Obshch. Khim.
Zhurnal Obshchei Khimii (U.S.S.R.)
Issued in English Translation as Journal of General Chemistry of The USSR

Zh. Org. Khim.
Zhurnal Organicheskoi Khimii (U.S.S.R.)
Issued in English Translation as Journal of Organic Chemistry of the USSR

Zh. Prikl. Khim.
Zhurnal Prikladnoi Khimii (U.S.S.R.)
Issued in English Translation as Journal of Applied Chemistry of the USSR

Zh. Prikl. Mekh. Tekh. Fiz.
Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (U.S.S.R.)
Issued in English Translation as Journal of Applied Mechanics and Technical Physics (USSR)

Zh. Prikl. Spektrosk.
Zhurnal Prikladnoi Spektroskopii (Belorussian S.S.R.)
Issued in English Translation as Journal of Applied Spectroscopy (USSR)

Zh. Strukt. Khim.
Zhurnal Strukturnoi Khimii (U.S.S.R.)
Issued in English Translation as Journal of Structural Chemistry (USSR)

Zh. Tekh. Fiz.
Zhurnal Tekhnicheskoi Fiziki (U.S.S.R.)
For English Translation see Soviet Physics-Technical Physics (U.S.)

Zh. Ushnykh Nesovykh Gorlovykh Bolez.
Zhurnal Ushnykh Nosovykh i Gorlovykh Bolezuei (Ukrainian S.S.R.)

Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva
Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva imeni D. I. Mendeleeva (U.S.S.R.)

Zh. Vychisl. Mat. i Mat. Fiz.
Zhurnal Vychislitelnoi Matematiki i Matematicheskoi Fiziki (U.S.S.R.)

Zh. Vyssh. Nerv. Deyateln. im. I. P. Pavlova
Zhurnal Vysshei Nervnoi Deyatelnosti imeni I. P. Pavlova (U.S.S.R.)

Z. Kinderheilk.
Zeitschrift fuer Kinderheilkunde (West Germany)

Z. Krebsforsch.
Zeitschrift fuer Krebsforschung (West Germany)

Z. Laryngol., Rhincl., Otol.
Zeitschrift fuer Laryngologie, Rhinologie, Otologie und Ihre Grenzgebiete (West Germany)

Z. Lebensm.-Untersuch. Forsch.
Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung (West Germany)

Z. Metallk.
Zeitschrift fuer Metallkunde (West Germany)

Z. Naturforsch., A
Zeitschrift fuer Naturforschung, Part A (West Germany)

Z. Naturforsch., B
Zeitschrift fuer Naturforschung. Part B (West Germany)

Zool. Zh.
Zoologicheskii Zhurnal (U.S.S.R.)

Z. Pflantzenzuecht.
Zeitschrift fuer Pflantzenzuechtung (Germany)

Z. Phys.
Zeitschrift fuer Physik (West Germany)

Z. Phys. Chem. (Frankfurt)
Zeitschrift fuer Physikalische Chemie (Frankfurt) (West Germany)

Z. Phys. Chem. (Leipzig)
Zeitschrift fuer Physikalische Chemie (Leipzig) (East Germany)
Supersedes Z. Phys. Chem. (Leipzig), A and B

Z. Tech. Ueberwach.
Zeitschrift Technische Ueberwachung (Austria)

Z. Tierphysiol. Tierernaehr. Futtermittelk.
Zeitschrift fuer Tierphysiologie Tierernaehrung und Futtermittelkunde (West Germany)

Z. Urol. Nephrol.
Zeitschrift fuer Urologie und Nephrologie (East Germany)

Zvaranie
Zvaranie (Czechoslovakia)

Z. Wasser- Abwasserforsch.
Zeitschrift fuer Wasser- und Abwasserforschung (West Germany)

Z. Wirt. Fertigung
Zeitschrift fuer Wirtschaftliche Fertigung (West Germany)

☆U. S. GOVERNMENT PRINTING OFFICE: 1971—745-063/14

UNITED STATES
ATOMIC ENERGY COMMISSION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U. S. ATOMIC ENERGY COMMISSION

G ...GE AND FEES PAID
...RNMENT PRINTING OFFICE

U.S.MAIL

UNIVERSITY MICROFILMS
SERIAL PUBLICATIONS
300 NORTH ZEEB ROAD
ANN ARBOR MICHIGAN 48106

1

AEC SYMPOSIUM SERIES

Available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151

1 **Progress in Medical Radioisotope Scanning** (TID-7673), Oak Ridge Institute of Nuclear Studies, 1963, $6.00

2 **Reactor Kinetics and Control** (TID-7662), The University of Arizona, 1964, $6.00

3 **Dynamic Clinical Studies with Radioisotopes** (TID-7678), Oak Ridge Institute of Nuclear Studies, 1964, $6.00

4 **Noise Analysis in Nuclear Systems** (TID-7679), University of Florida, 1964, $6.00

5 **Radioactive Fallout from Nuclear Weapons Tests** (CONF-765), U. S. Atomic Energy Commission, 1965, $6.00

6 **Radioactive Pharmaceuticals** (CONF-651111), Oak Ridge Institute of Nuclear Studies, 1966, $6.00

7 **Neutron Dynamics and Control** (CONF-650413), The University of Arizona, 1966, $6.00

8 **Luminescence Dosimetry** (CONF-650637), Stanford University, 1967, $6.00

9 **Neutron Noise, Waves, and Pulse Propagation** (CONF-660206), University of Florida, 1967, $6.00

10 **Use of Computers in Analysis of Experimental Data and the Control of Nuclear Facilities** (CONF-660527), Argonne National Laboratory, 1967, $6.00

11 **Compartments, Pools, and Spaces in Medical Physiology** (CONF-661010), Oak Ridge Associated Universities, 1967, $6.00

12 **Thorium Fuel Cycle** (CONF-660524), Oak Ridge National Laboratory, 1968, $6.00

13 **Radioisotopes in Medicine: In Vitro Studies** (CONF-671111), Oak Ridge Associated Universities, 1968, $6.00

14 **Abundant Nuclear Energy** (CONF-680810), Oak Ridge Associated Universities, 1969, $6.00

15 **Fast Burst Reactors** (CONF-690102), The University of New Mexico, 1969, $9.00

16 **Biological Implications of the Nuclear Age** (CONF-690303), Lawrence Radiation Laboratory, 1969, $6.00

17 **Radiation Biology of the Fetal and Juvenile Mammal** (CONF-690501), Pacific Northwest Laboratory, 1969, $9.00

18 **Inhalation Carcinogenesis** (CONF-691001), Oak Ridge National Laboratory, 1970, $6.00

19 **Myeloproliferative Disorders of Animals and Man** (CONF-680529), Pacific Northwest Laboratory, 1970, $9.00

20 **Medical Radionuclides: Radiation Dose and Effects** (CONF-691212), Oak Ridge Associated Universities, 1970, $6.00

21 **Morphology of Experimental Respiratory Carcinogenesis** (CONF-700501), Oak Ridge National Laboratory, 1970, $6.00

22 **Precipitation Scavenging (1970)** (CONF-700601), Pacific Northwest Laboratory, 1970, $6.00

23 **Neutron Standards and Flux Normalization** (CONF-701002), Argonne National Laboratory, 1971, $6.00